IC-720A

HF ALLBAND* TRANSCEIVER
GENERAL COVERAGE RECEIVER

INSTRUCTION MANUAL

ICOM

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SECTION 1 SPECIFICATIONS

GENERAL

Number of Semi-Conductors:

Transistors	105
FET	16
IC (Includes CPU)	51
Diodes	219

Frequency Coverage:

Ham Band	1.8MHz ~ 2.0MHz
	3.5MHz ~ 4.1MHz
	6.9MHz ~ 7.5MHz
	9.9MHz ~ 10.5MHz
	13.9MHz ~ 14.5MHz
	17.9MHz ~ 18.5MHz
	20.9MHz ~ 21.5MHz
	24.5MHz ~ 25.1MHz
	28.0MHz ~ 30.0MHz
General Cover (Receive Only)	
	0.1MHz ~ 30.0MHz
	Thirty 1MHz Segments

Frequency Control:
CPU based 10Hz step Digital PLL synthesizer.
Independent Transmit-Receive Frequency Available on same band.

Frequency Readout:
6 digit 100Hz readout.

Frequency Stability:
Less than 500Hz after switch on 1 min to 60 mins, and less than 100Hz after 1 hour. Less than 1KHz in the range of $-10^{\circ}C$ to $+60^{\circ}C$.

Power Supply Requirements:
DC 13.8V ±15% Negative ground Current drain 20A max. (at 200W input)
AC power supply is available for AC operation.

Antenna Impedance:
50 ohms Unbalanced

Weight:
7.5Kg

Dimensions:
111mm(H) x 241mm(W) x 311mm(D)

TRANSMITTER

RF Power:

SSB (A_3J)	200 Watts PEP input
CW (A_1), RTTY (F_1)	200 Watts input
Continuously Adjustable Output power 10 Watts ~ Max.	
AM (A_3)	40 Watts output

Emission Mode:

A_3J	SSB (Upper sideband and Lower sideband)
A_1	CW
F_1	RTTY (Frequency Shift Keying)
A_3	AM

Harmonic Output:
More than 40dB below peak power output

Spurious Output:
More than 60dB below peak power output

Carrier Suppression:
More than 40dB below peak power output

Unwanted Sideband:
More than 40dB down at 1000Hz AF input

Microphone:
Impedance 1300 ohms
Input Level 120 millivolts typical
Dynamic or Electret Condenser Microphone with Preamplifier

RECEIVER

Receiving System:
Quadruple Conversion Superheterodyne with continuous Bandwidth Control.

Receiving Mode:
A_1, A_3J (USB, LSB) F_1 (Output FSK audio signal), A_3

IF Frequencies:

1st	39.7315MHz
2nd	9.0115MHz
3rd	10.75MHz
4th	9.0115MHz

with continuous Bandwidth Control

Sensitivity:
Less than 0.25 microvolts for 10dB S+N/N

Selectivity:

SSB, CW, RTTY	±1.15KHz at –6dB
	(Adjustable to ±0.4KHz Min)
	±2.1KHz at –60dB
CW-N	
(when optional filter installed)	
	±250Hz at –6dB
	±750Hz at –60dB
AM	±3.0KHz at –6dB
	±9.0KHz at –60dB
(when optional filter installed)	
	±2.6KHz at –6dB
	±6.0KHz at –60dB

Spurious Response Rejection Ratio:
More than 60dB

Audio Output:
More than 2 Watts

Audio Output Impedance:
8 ohms

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JAMESTOWN, N.Y.
14701

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Specifications are approximate and are subject to change without notice or obligation.

SECTION 2 FEATURES

REAL ALL BAND, ALL MODE, ALL SOLID STATE

The IC-720A covers all the Amateur HF frequencies from 1.8MHz to 29.999.9MHz, including the new three bands. It offers not only SSB, but also AM, CW and RTTY. All of the circuits in the IC-720A, including the driver and final power stages are completely solid state, and provide about 100 Watts output.

GENERAL COVERAGE RECEIVER CAPABILITY

The IC-720A has capabilities for an all amateur band transceiver as well as a general coverage receiver between 100KHz and 30MHz with thirty 1MHz segments. The Up-conversion system using a high side IF and Microcomputer Control System make these capabilities possible.

In addition to these, the low-pass filters switched by rotary relay and the band-pass filters selected by an electric signal from the BAND UP/DOWN button, make a no tune-up system.

DUAL 10Hz STEP DIGITAL VFO

The dual digital VFO consists of the PLL unit, which has a triple looped Phase-Locked-Loop, and the LOGIC unit, used to control the PLL, has the Microcomputer Control System.

Three tuning frequency resolutions of 10Hz, 100Hz and 1KHz steps are selectable with the TS button and the TUNING RATE SELECT switch. Two separate VFO's can be used independently in the SIMPLEX operation, and any desired in band frequency split transmit/receive in the DUPLEX operation.

OUTSTANDING RECEIVER PERFORMANCE

The IC-720A employs a dual conversion superheterodyne system which has the first IF at 39.7315MHz and the second IF at 9.0115MHz.

The RF amplifier circuit is a wide band push-pull amplifier using low-noise and wide dynamic range junction FET's, and the mixer is a high level Double Balanced Mixer developed by ICOM.

These advanced devices and system give higher spurious response rejection ratio, higher sensitivity and wider dynamic range.

PASS-BAND TUNING AND SPEECH PROCESSOR

The IC-720A has a built-in Pass-Band Tuning system developed by ICOM that allows you to continuously adjust the pass band of the IF. By turning the control, you can eliminate interference from a nearby signal, thus providing clear reception. It can also be used as a tone control. During transmit, the Pass-Band Tuning circuit can be used as a Speech Processor providing increased "talk power" for outstanding DXing.

ADDITIONAL CIRCUITS

The IC-720A has a built-in Noise Blanker, VOX, CW Monitor, APC, SWR detector, and many other circuits for your convenience.

The IC-720A has everything you need to really enjoy HF operation, in an extremely compact, rugged transceiver.

BE SURE TO READ THE FOLLOWING INSTRUCTIONS BEFORE USE.

3 - 1 UNPACKING

Carefully remove your transceiver from the packing carton and examine it for signs of shipping damage. Should any be apparent, notify the delivering carrier or dealer immediately, stating the full extent of the damage. It is recommended you keep the shipping cartons. In the event storage, moving, or reshipment becomes necessary they will be handy. Accessory cables, plugs, etc., are packed with the transceiver. Make sure you have not overlooked anything.

1. Microphone (IC-HM7) 1
2. DC Power Cord 1
3. Pin Plugs (Low Band ANT Terminal Plug, Transverter Terminal Plug) 2
4. External Speaker Plug 1
5. Key Plug 1
6. Spare Fuses (20 Amp) 2

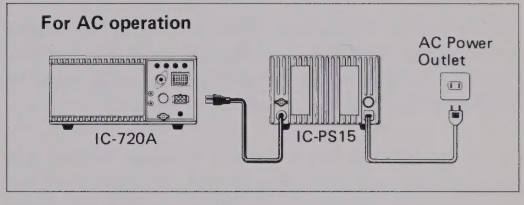
3 - 2 RECOMMENDATIONS FOR INSTALLATION

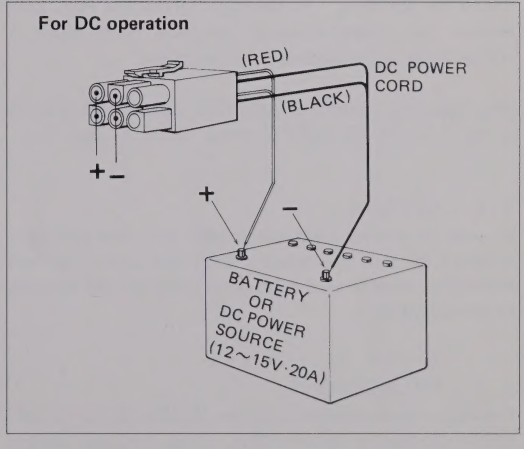
1. Avoid placing the IC-720A in direct sunlight, high temperature, dusty or humid places.
2. The sides of the unit, when facing it, function also as heatsinks. The temperature there will usually become relatively warm during transmission. Any equipment should be at least 1 inch (3cm) away from the unit so as to provide good ventilation. Be sure that nothing is on and just behind the rear PA heatsink to ensure good ventilation. Also avoid places near outlets of heaters, air conditioners, etc.
3. Place the unit so that the controls and switches can easily be handled and the frequency indication and meter can easily be read.
4. For mobile installation, an optional mounting bracket is available. Select the best location that can stand the weight of the unit and that does not interfere with your driving in any way.
5. Use the Ground Lug!

3 - 3 POWER SUPPLY

For AC operation, use the special power supply IC-PS15. If you would like to use your car battery or any other DC power supply, be sure that its output voltage is 12-15 Volts and the current capacity is at least 20 Amps. The maximum power consumption of the set during transmission runs from 16-20 Amps, so keep that in mind if the unit is installed in your automobile, and turn it on after you have started the engine. Attention should also be paid to the condition of the battery and electrical system.

The connection of the DC power cord supplied with the IC-720A is done in the following way: First make sure that the power switch of the unit is in the OFF position and the T/R switch is in the receive position. Connect the cord to the DC power supply with the RED lead to the positive terminal and the BLACK lead to the negative terminal. (Reverse connection will cause the protection circuit to operate and blow the fuse.) Connect the DC plug to the socket on the rear panel of the IC-720A. Refer to the drawing below.

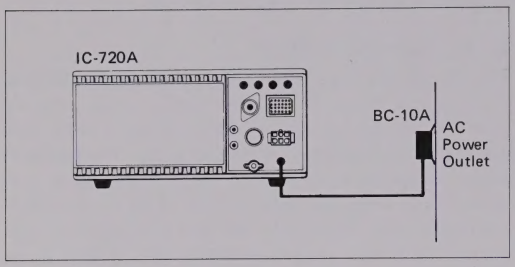




3 - 4 MEMORY BACK-UP

To retain the memory in the CPU, keeping the operating frequencies of the VFOs even when the main Power Switch is turned OFF, connect a power source of 9 to 12 Volts DC to the Memory Back-Up terminal on the rear panel. For mobile installation this can be accomplished by direct connection to the car battery, since the current drain is low.

For AC operation it is recommended that the optional BC-10A be used.



3 - 5 ANTENNA

Antennas play a very important role in radio communication. If the antenna is inferior, your transceiver cannot give you the best performance. With a good antenna and feeder cable having 50 ohms impedance, you should easily get the desired matching and performance. Carefully install a high performance antenna that suits the frequency band(s) you wish to operate on and place it as high as possible. Be especially careful of the condition of the connectors as loose connections will deteriorate the performance. Be sure to connect the ground terminal of a whip antenna, if used, to the body of your car.

As the output is quite high, avoid connecting the antenna connector to open lines and do not transmit under mismatched conditions. Otherwise the final stage could be overloaded and cause a malfunction of the unit.

Since the IC-720A has a General Coverage receiver it is recommended that a long-wire general coverage antenna and an antenna coupler be used. The antenna's impedance should be 50 ohms. To attempt to use the Ham band antenna for general coverage reception could result in mismatching, and attendant poor reception.

When receiving lower than 1600KHz, connect the antenna to the "LOW BAND ANT" terminal. (Refer to page 21.)

3 - 6 GROUND

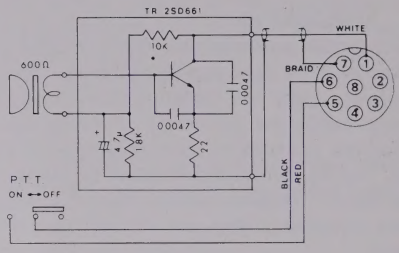
In order to prevent electrical shocks, TVI, BCI and other problems, be sure to connect a heavy wire ground, as short as possible, from a good earth point to the ground terminal on the rear panel.

3 - 7 MICROPHONE

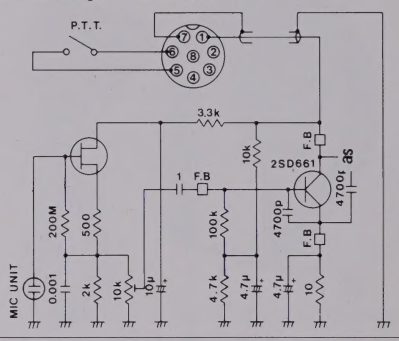
The microphone supplied with the IC-720A is the IC-HM7 which contains a pre-amplifier. The optional electret condenser type stand microphone IC-SM5 can be used. Their circuit diagrams are shown.

Should you wish to use a different microphone, make certain it has a proper pre-amplifier.

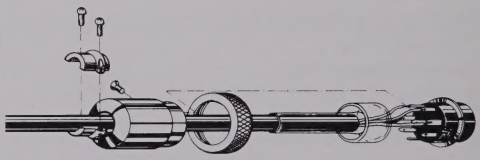
Schematic diagram of IC-HM7



Schematic diagram of IC-SM5



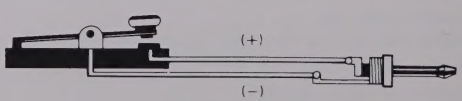
Microphone plug exploded View



3 - 8 CW KEY

When operating CW, connect the Key to the Key Jack with the plug supplied. The connection of the plug is shown below.

Key Wiring Diagram



If the terminals have polarity, be sure to make the correct connection. Note that the keyed voltage when switching with semiconductors or relays with resistors in the circuit, should be adjusted to be below 0.4 Volts!

3 - 9 RTTY

When operating RTTY, connect the ACC socket pins 8 (ground) and 9 to your tele-typewriter through a high speed relay or a level converter to TTL level, and the tones for your terminal unit will be available from pin 4. The AF output level is about 300mV P-P for S-9 signal. For details, refer to 5 - 4 RTTY OPERATION on page 18.

3 - 10 EXTERNAL SPEAKER

The IC-720A contains an internal speaker, and is also designed so that it can drive an external speaker from the external (EXT) speaker jack on the rear panel. Be sure the impedance of the external speaker is 8 ohms, and remember that with the external speaker connected, the internal speaker is disabled.

3 - 11 HEADPHONES

Any good headphone set, including stereo type, that have 4-16 ohms impedance can be used. With the plug inserted halfway into the PHONES jack, both the headphone and speaker will operate. This is convenient when others wish to listen in on the station, or you wish to record contacts using a tape recorder connected to the headphone jack. With a stereo headphone set inserted this way, however, the headphone will lose the sound on one side. With the plug inserted completely, only the headphone works.

3 - 12 COOLING FAN

The rear of the PA unit is designed to provide for adequate cooling, but with 200 Watts input the final stage produces quite a bit of heat, and its temperature may rise during prolonged transmissions. The fan is connected to a temperature monitoring circuit which monitors the temperature of the final stage. The fan operates as follows:

1. The fan does not operate in the receive mode, but will run all the time in transmit.
2. When the temperature rises to a point detected by the monitor curcuit the fan will operate during both transmit and receive to provide additional cooling.
3. If the temperature rises to a danger limit the fan will run much more rapidly. At this time stop transmitting and investigate the cause of overheating i.e. antenna mismatch, etc. Correct the cause of the overheating before starting to transmit again.

3 - 13 POWER SUPPLY

It is recommended that you use the IC-PS15 as a power supply for base operation. If you wish to use another type power supply make sure that it meets the voltage, current requirements. Note carefully the overvoltage protection, for a runaway regulator can destroy the IC-720A; be especially careful that more than 16 Volts cannot be supplied to the transceiver. Do not connect the power supply, antenna, accessory plug, or microphone with the Power Switch in the ON position. Be especially careful not to transmit without an antenna or dummy load hooked up. If the fuse blows replace it with a 20 Amp fuse, only after fixing the cause. Do not turn the Power Switch ON and OFF repeatedly for this way cause the readout to mis-display. Should this occur, turn the set OFF and wait for approximately 30 seconds before turning it back ON.

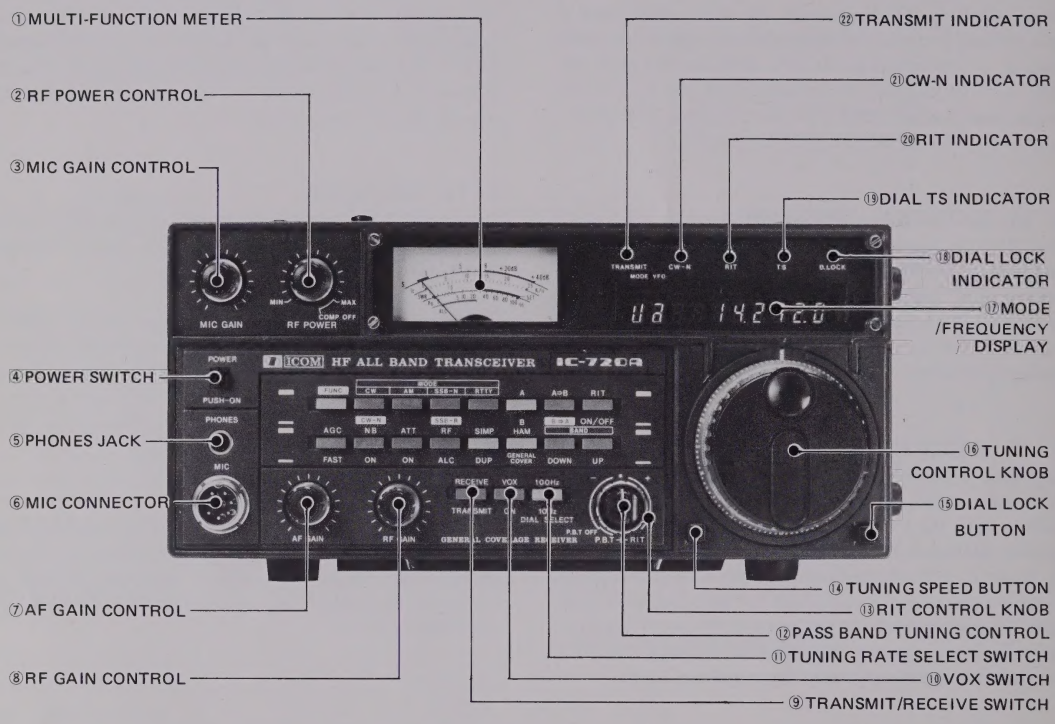
3 - 14 CAUTIONS

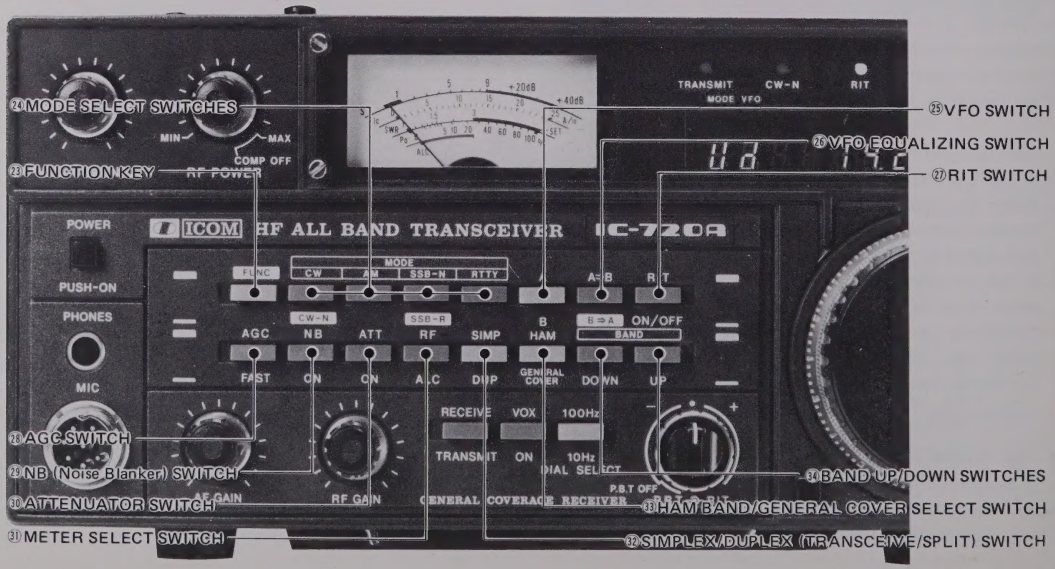
As the unit has already been closely adjusted with highly sophisticated measuring instruments, never tamper with the turnable resistors, coils, trimmers, etc.

C-MOS is used in the Logic unit as well as the PLL. C-MOS ICs are very susceptible to excessive static charges and overcurrent and care must be used when handling them. Therefore, avoid touching the Logic unit and the nearby circuitry unless absolutely necessary. When it is necessary to check the circuitry, observe the following points.

Ground all measuring instruments, the soldering iron, and other tools. Do not connect or disconnect the C-MOS IC from its socket, or solder it when the power is on. Do not apply voltage of less than –0.5 or more than +5 Volts to the input terminals of the IC. DO NOT MEASURE WITH AN OHMMETER.

4 - 1 FRONT PANEL





1. MULTI-FUNCTION METER

When in the receive mode the meter acts as an S meter regardless of the position of the meter select switch. Signal strength is indicated on a scale of S1-S9, and S9+20dB to S9+40dB.

In the transmit mode the meter has three functions which are selected by the Meter Select Switch (31) and the IC Meter Switch inside the top access cover. They are as follows:

Ic; Indicates the collector current of the final transistors.

Po; Indicates the relative output power. SWR can be measured by placing the switch located inside the top cover to the SWR position.

ALC; In this position the meter functions when the RF output reaches a certain level.

2. RF POWER CONTROL

The IC-720A has a built-in RF speech processor which is turned ON by turning the control counterclockwise, from the COMP OFF position. (a click will be heard.) In the ON position. it functions as the RF drive control, as explained in the MIC GAIN CONTROL paragraph. In CW, SSB and RTTY modes it operates as the output level control of the IC-720A. When this function is not desired the control should be turned completely clockwise until COMP OFF, and a click is heard.

3. MIC GAIN CONTROL

Adjusts the level of modulation according to the input of the microphone. Clockwise rotation increases the microphones gain. As the input will vary with different microphones and different voices, the knob should be turned until the Multi-Function Meter needle, in the ALC mode, begins to move slightly within the ALC zone. In SSB and AM modes, when the RF speech processor is in use, the MIC GAIN CONTROL sets the clipping limits, while the RF POWER CONTROL sets the RF drive level to the maximum power level, where ALC starts at the saturation point of the amplifiers.

4. POWER SWITCH

The POWER SWITCH is a push-lock type switch which controls the input DC power to the IC-720A. When the external AC power supply (IC-PS15) is used, the switch also acts as the AC power supply switch. When the switch is pushed in and locked, power is supplied to the set. When the switch is pushed again and released, power is cut to all circuits except the PA unit. (When the BC-10A is used, power will also be supplied to the CPU.)

5. PHONES JACK

Accepts a standard 1/4 inch headphone plug for headphones of 4 ~ 16 ohms. Stereo phones can be used without modification.

6. MIC CONNECTOR

Connect the supplied microphone or optional microphone IC-SM5 to this jack. If you wish to use a different microphone, refer to the drawing on page 4.

7. AF GAIN CONTROL

Controls the audio output level in the receive mode. Clockwise rotation increases the level.

8. RF GAIN CONTROL

Controls the gain of the RF section in the receive mode. Clockwise rotation gives the maximum gain. As the control is rotated counterclockwise, the needle of the MULTI-FUNCTION METER rises, and only signals stronger than the level indicated by the needle will be heard.

9. TRANSMIT/RECEIVE (T/R) SWITCH

This switch is for manually switching from transmit to receive and vice versa. Set the switch to RECEIVE (out) and the IC-720A is in the receive mode. Set the switch to TRANSMIT (in) and it switches to transmit. When switching with the PTT switch on the microphone or with the VOX switch set to ON, the T/R switch must be in the RECEIVE position.

10. VOX SWITCH

This switches the VOX circuit ON and OFF. When it is in the ON (in) position, in SSB or AM, T/R switching is accomplished by means of a voice signal. In CW operation, semi-break-in switching by means of keying is possible.

11. TUNING RATE SELECT SWITCH

The small vernier marks on the tuning knob are changed to correspond to 10Hz steps or 100Hz steps which is selected by this switch.

12. P.B. TUNE (PASS BAND TUNING) CONTROL

Allows continuous tuning of the pass-band selectivity by moving the filter up to 800Hz from the upper or lower side in SSB, CW and RTTY. Not only improves selectivity, but also can improve the audio tone. Normal position is in the center (12 o'clock) position and is 2.3KHz wide in SSB.

13. RIT CONTROL

Shifts the receive frequency ±800Hz either side of the transmit frequency. When the RIT is ON, the RIT INDICATOR is illuminated. Rotating the control to the (+) side raises the receiver frequency, and rotating to the (—) side lowers the receiver frequency. With the RIT ON, if the TUNING CONTROL KNOB is moved one increment, the RIT circuit is automatically pulsed OFF. Therefore it is unnecessary to manually turn OFF the RIT when changing operating frequency. The frequency shift by tuning the RIT Control is not indicated on the frequency display.

14. TUNING SPEED BUTTON

Pushing the TUNING SPEED BUTTON will illuminate the DIAL TS INDICATOR, and the small vernier marks on the tuning knob are changed to correspond to 1KHz steps. At the same time, the 100Hz digit is turned OFF on the display. When the TUNING SPEED BUTTON is depressed again, the DIAL TS INDICATOR goes OFF and the small vernier marks will again correspond to 100Hz steps or 10Hz steps.

This button will allow you to quickly QSY over a great frequency range.

15. DIAL LOCK BUTTON

After the IC-720A is set to a certain frequency for rag chewing, mobile operation, etc., pushing the DIAL LOCK BUTTON will illuminate the DIAL LOCK INDICATOR and the VFO is electronically locked at the displayed frequency, thus inactivating the operation of the tuning knob. To change frequency, the dial lock must first be disengaged by pushing the DIAL LOCK BUTTON again. The DIAL LOCK INDICATOR will go OFF and the frequency will change with the direction of the tuning knob rotation. Turning the power OFF will release the dial lock and clear the displayed frequency.

16. TUNING CONTROL KNOB

Rotating the TUNING CONTROL KNOB clockwise increases the frequency, while rotating it counterclockwise decreases the frequency. The frequency is changed in 10Hz, 100Hz or 1KHz steps which is according to the TUNING RATE SELECT switch and the TUNING SPEED BUTTON. One complete rotation of the tuning knob results in a 1KHz frequency increase or decrease in 10Hz steps, 10KHz in 100Hz steps and 100KHz in 1KHz steps.

17. MODE/FREQUENCY DISPLAY

The frequency of the IC-720A is displayed on a luminescent display tube. Since the 1MHz and 1KHz decimal points are displayed, the frequency can easily be read. The frequencies indicated are the carrier frequencies of each mode in AM, USB, LSB and CW. In the RTTY mode, the mark frequency is displayed.

Remember, if you turn the RIT SWITCH ON to change the receive frequency and rotate the RIT CONTROL knob, the frequency displayed will not change.

The letters shown to the left of the frequency indication are the initial letter of the operating mode and the letter of the operating VFO.

18. DIAL LOCK INDICATOR

Illuminates when the DIAL LOCK BUTTON is pressed to lock the dial.

19. DIAL TUNING SPEED (TS) INDICATOR

Illuminates when the TUNING SPEED BUTTON is pressed to set the dial to fast tuning.

20. RIT INDICATOR

Illuminates when RIT is turned ON.

21. CW-N (CW NARROW) INDICATOR

Illuminates when the set is in CW-N mode. This indicator illuminates not only when the optional CW filter is installed, but also if it is not installed.

22. TRANSMIT INDICATOR

Illuminates when the transceiver is in the transmit mode.

23. FUNCTION KEY

Increases the function of the CW and SSB MODE SELECT switches and the VFO EQUALIZING switch by pushing this key switch.

24. MODE SELECT SWITCHES

Selects any one of four operating modes by simply pushing the desired switch. Additionally, the CW and SSB switches have dual functions as follows.

1. CW : For normal CW operation.
   CW-N : Pushing the FUNCTION key first, then the CW button, filter is switched to the Narrow CW filter (when the optional Narrow CW filter is installed).

2. SSB-N : For normal SSB operation, upper sideband (USB) for 10MHz band and above, and lower sideband (LSB) for 9MHz band and below.
   SSB-R : For reverse SSB operation, lower sideband (LSB) for 10MHz band and above, and upper sideband (USB) for 9MHz band and below.

25. VFO SWITCH

You can select either of the built-in two VFO's with this switch. It also selects the relationship of the two VFO's with the SIMPLEX/DUPLEX switch. The switch performs the following operations according to its position.

A. (SIMPLEX) Selects the "A" VFO for both transmit and receive.

A. (DUPLEX) Selects "A" VFO for receive and "B" VFO for transmit.

B. (SIMPLEX) Selects the "B" VFO in both transmit and receive.

B. (DUPLEX) Selects "B" VFO for receive and "A" VFO for transmit.

NOTE: The set will not transmit in the GENERAL COVER mode.

In addition, when the VFO is switched from "A" VFO to "B" VFO, the frequency indicated on the frequency display just prior to switching goes into a memory inside the CPU. Thus even if "B" VFO is being used, switching to "A" again will enable you to operate at the initial frequency. Switching from "B" to "A" results in the same operation.

26. VFO EQUALIZING SWITCH

When "A" VFO and "B" VFO have different frequencies, by pushing this switch, "B" VFO will have the same frequency as "A" VFO. This switch has dual functions, by pushing the FUNCTION key first, then this switch, "A" VFO will have the same frequency as "B" VFO.

27. RIT SWITCH

Push once for ON; if OFF is desired push the switch again.

When the RIT is ON the RIT INDICATOR will light. (Note: The RIT will also pulse OFF when the TUNING CONTROL knob is turned.)

28. AGC (AUTOMATIC GAIN CONTROL) SWITCH
For changing the time-constant of the AGC circuit. With the switch in the AGC position (out) the AGC voltage is released slowly, and thus is suitable for SSB reception. With the switch in the FAST (in) position, the AGC voltage is released faster, and the AGC is suitable for stations suffering from fast fading or when operating in the CW mode.

29. NB (NOISE BLANKER) SWITCH
When pulse type noise such as automobile ignition noise is present, set this switch to the ON (in) position. The noise will be reduced to provide comfortable reception.

30. ATT (ATTENUATOR) SWITCH
When nearby signals interfere with reception, or make "S" readings difficult push the switch in, this removes the RF Amplifier from the receiving circuit, and an attenuator is put into the circuit. For normal operation leave it in the OFF (out) position.

31. METER SELECT SWITCH
Selects meter function in the transmit mode.

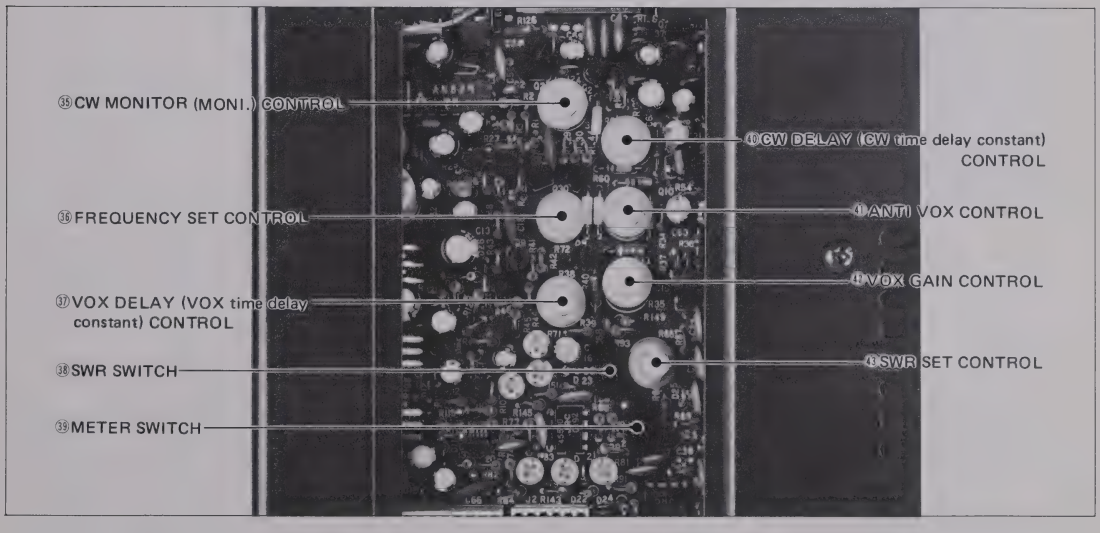
32. SIMPLEX/DUPLEX (TRANSCEIVE/SPLIT) SWITCH
Selects the relationship of the two VFO's. In the SIMPLEX (out) position, one VFO is for both transmit and receive. In the DUPLEX (in) position, one VFO is for transmit and the other is for receive.

33. HAM BAND/GENERAL COVER SELECT SWITCH
Selects the function of the set. In the HAM (out) position the transceiver functions in any of nine HAM bands between 1.8MHz and 28MHz. In the GENERAL COVER position (in) the set functions as a general coverage receiver between 0.1MHz and 30MHz. (the set will not transmit in this mode.)

34. BAND UP/DOWN SWITCHES
Changes the operating band upward or downward. In the HAM BAND operation, the band skips to the next upper or lower band with each push. (28MHz band is divided into two segments of 28-29MHz and 29-30MHz.)

In the GENERAL COVERAGE operation, the band changes to next upper or lower 1MHz segment. When the band reaches the highest band, the next is the lowest band. Also when the band reaches the lowest band, the next is the highest band.

4 - 2 CONTROLS UNDER THE ACCESS COVER



35. CW MONITOR (MONI) CONTROL
This control adjusts the audio volume of the side tone (monitor) audio during CW transmit operation. Adjust it to your desired level for easy listening.

36. FREQUENCY SET CONTROL
This control is for fine adjustment of the reference frequency of the PLL unit, which is local oscillator frequency. Do not turn it unless you want to change the frequency.

37. VOX DELAY (VOX time constant) CONTROL
This controls the transmit to receive switching time. Adjust it so transmit to receive switching will not occur during short pauses in normal speech.

38. SWR SWITCH
When measuring SWR, calibration SET and SWR reading functions are selected with this switch. When reading SWR make sure the METER SELECT switch on the front panel

is in the RF position.

39. METER SWITCH
When the METER SELECT switch on the front panel is in the RF position, this switch is used to select indication of the collector current of the final transistors, or relative output power.

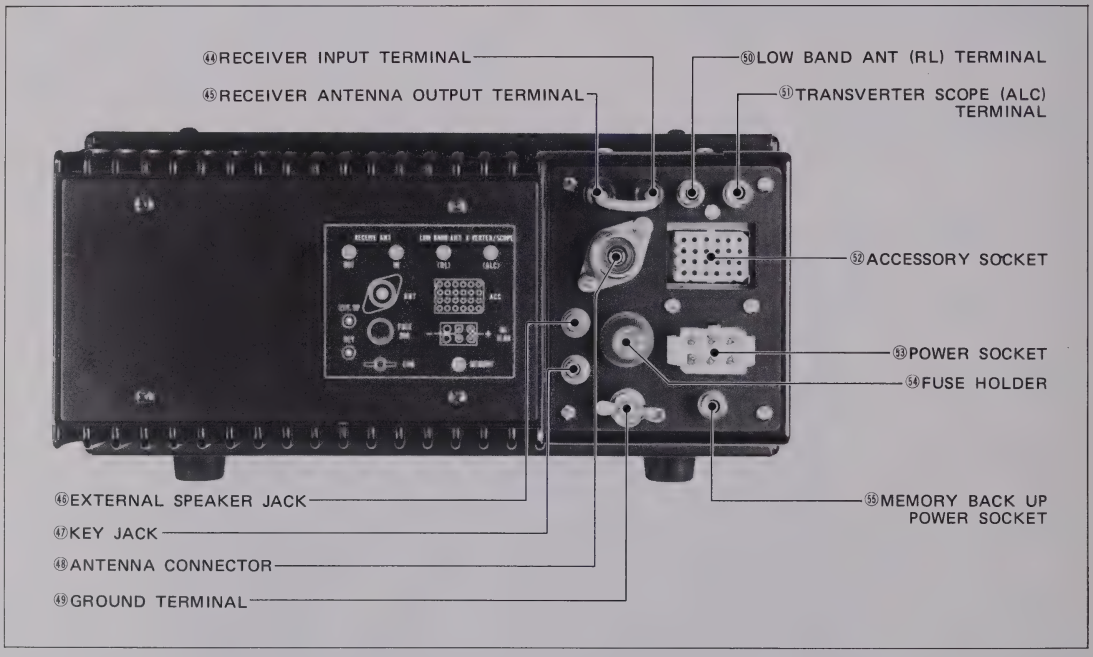
40. CW DELAY CONTROL
In semi-break-in operation, this controls the transmit/receive switchover time-delay. Adjust to suit your keying speed. (Note: If the delay is set to the shortest position, it will reach almost full break-in CW.)

41. ANTI-VOX CONTROL
In VOX (SSB and AM) operation, the VOX circuit may be operated by sound from the speaker causing a switch to transmit. This trouble can be prevented by adjusting the input level of the ANTI VOX circuit with this control along with the VOX gain control so that the VOX circuit only operates from the operator's voice, not by sound from the speaker.

42. VOX GAIN CONTROL
This control adjusts input signal level via the microphone to the VOX circuit. For VOX operation in SSB and AM, adjust the control so that the VOX circuit will operate with normal speech.

43. SWR SET CONTROL
This control calibrates the meter needle to the Po SET position when you want to determine the value of SWR. The METER SELECT switch must be in the RF position and the set must be transmitting a carrier.

4-3 REAR PANEL CONNECTIONS



44. RECEIVER INPUT TERMINAL
This is an input terminal which is connected directly to the receiver.

45. RECEIVER ANTENNA OUTPUT TERMINAL
This is a terminal to which received signals from the antenna connector are conducted after the signal passes through the transmit/receive antenna switching circuit. Usually the receiver IN and OUT terminals are jumpered. The receiver antenna output terminal is usually used when another receiver is used or a pre-amplifier is connected to the IC-720A.

46. EXTERNAL SPEAKER JACK
When an external speaker is used, connect it to this jack. Use a speaker with an impedance of 8 ohms. When the external speaker is connected, the built-in speaker does not function.

47. KEY JACK
For CW operation, connect the key here. For electronic keying the terminal voltage must be less than 0.4V DC.

48. ANTENNA (ANT) CONNECTOR
This is used to connect the antenna to the set. Its impedance is 50 ohms and connects with a PL-259 connector.

49. GROUND TERMINAL
To prevent electrical shock, TVI, BCI and other problems, be sure to ground the equipment through the GROUND

TERMINAL. For best results use as heavy a gauge wire or strap as possible and make the connection as short as possible, even in mobile installations.

50. LOW BAND ANTENNA (RL) TERMINAL

For connection of a low band antenna to receive 1600KHz and below. When operating frequency goes to 1600KHz and below, the antenna terminal will be changed from (48) ANTENNA connector to this terminal automatically.

By changing an internal connector, this terminal can be used for a Transmit/Receive relay control terminal. This terminal can be used to switch 24V 1A DC. Don't exceed this limit.

51. TRANSVERTER/SCOPE (ALC) TERMINAL

By changing internal connectors, this terminal can be used for a TRANSVERTER terminal, SCOPE terminal, or external ALC signal input terminal.

1. TRANSVERTER

   VHF and UHF operation using a suitable transverter with the IC-720A is possible. This terminal is for Transverter connection. The output is a few milliwatts. Refer to the tranverters instruction.

2. SCOPE

   This terminal brings out the 39.7MHz IF signal from the mixer in the receiver. Not only observation of the received signal, but also of signals of a selected band width are possible by using a panadaptor or panascope.

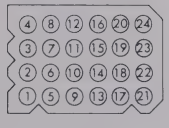
3. EXTERNAL ALC

   This terminal can be used for an input terminal of external ALC signal from a linear amplifier or transverter.

52. ACCESSORY (ACC) SOCKET

Various functions are available through the accessory socket such as frequency control, modulation output, receiver output, T/R changeover, and so forth. The table below shows those terminals.

ACC SOCKET CONNECTIONS



Outside view

PIN No.	FUNCTION
1.	NC (no connection)
2.	13.8 Volts DC in conjunction with the power switch operation.
3.	Connected to Push-to-talk, T/R change-over switch. When grounded, the set operates in the transmit mode.
4.	Output from the receiver detector stage. Fixed output regardless of AF output or AF gain.
5.	Output from Transmitter MIC amplifier stage. (Input for MIC gain control stage.)
6.	8 Volts DC available when transmitting. (relay can not be directly actuated. Max. 5mA.)
7.	Input for external ALC voltage.
8.	Ground
9.	Input for RTTY keying (MARK: HIGH level, SPACE: LOW level).
10.	Input for TRVA transverter control signal.
11.	Input for TRVB transverter control signal.
12.	Output reference voltage for band switching.
13.	INPUT/OUTPUT for external band switching.
14.	Input for TUNE mode. When +9V is applied, the set operates in the CW transmit mode.
15.	Input for external Noise Blanker control.
16.	Input for external control (DBC signal).
17.	NC
18.	Input for external control (RC signal).
19.	Output for external control (DV signal).
20.	Input for external control (RT signal).
21.	Input/Output for external control (DB1).
22.	Input/Output for external control (DB2).
23.	Input/Output for external control (DB4).
24.	Input/Output for external control (DB8).

53. POWER SOCKET

For connection of the IC-PS15's DC power cord, or other suitable power supply.

54. FUSE HOLDER

This holds the fuse for the DC power circuit. If the fuse is blown, replace it with a new 20 Amp fuse after checking the cause. Open the fuse holder with a Phillips head screw driver.

55. MEMORY BACKUP POWER SOCKET

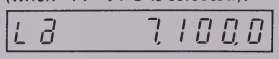
For connection of a 9 ~ 12V DC power supply. For mobile installation connection to the vehicle's battery can be made as the current drain is low, for fixed installation use of the IC-BC10A is recommended.

5-1 HOW TO TUNE

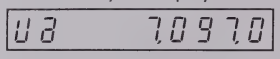
The following instructions are for tuning in any mode. Please read carefully and understand fully before turning ON your unit. Proper tuning is necessary for optimum operation.

5-1-1 FREQUENCY DISPLAY IN EACH MODE

In the HAM band mode, when the set is first turned ON, the following readouts will appear on the MODE/FREQUENCY DISPLAY (when "A" VFO is selected).



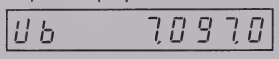
If the Function Key is pushed and then the SSB button, USB will be selected. In that case, the display will be:



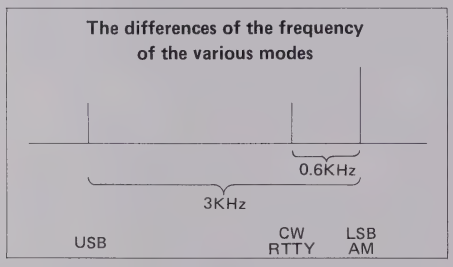
When changing to other modes, the display will be as follows:

CW or CW-N (Narrow):	C 3	7.099.4
AM:	A 3	7.100.0
RTTY:	r 3	7.099.4

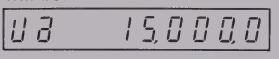
When "B" VFO is selected, the display will be:



To avoid the trouble of recalibrating the dial when you change the operating mode, the displayed frequency is set to shift to the carrier frequency of each mode automatically. For the differences of the frequency shifts of the various modes, refer to the following figure.



In the GENERAL COVERAGE mode, when the set is first turned ON, the display will be:

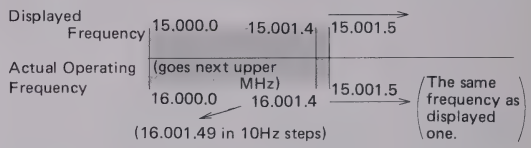


The frequency shifts of the various modes are the same as those of the HAM band, refer to the above figure.

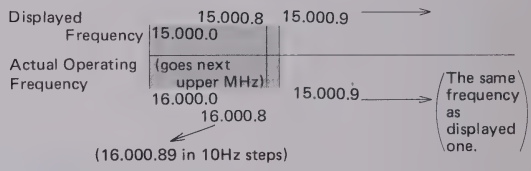
In the SSB mode, the sideband will be automatically selected to the one usually used on the band, i.e., upper sideband (USB) for the 10MHz band and above, and lower sideband (LSB) for the 7MHz band (9MHz band in the GENERAL COVERAGE mode) and below. If reverse sideband is desired, push the FUNCTION key first, then push the SSB switch.

CAUTION: In the GENERAL COVERAGE mode, displayed frequency and actual operating frequency are different at the band edges of the each band as per the following figures.

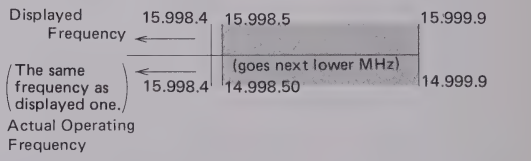
In the LSB or AM mode (at the low edge of 15MHz band).



In the CW or RTTY mode (at the low edge of 15MHz band).



In the USB mode (at the high edge of 15MHz band).



5-1-2 TUNING KNOB

The transmit or receive frequency is displayed on a 7-segment Electroluminesent display down to 100Hz digits. With all buttons in their normal (out) position, rotating the tuning knob clockwise increases the frequency, while turning counterclockwise decreases the frequency in 100Hz steps (or 10Hz steps, it depends on Tuning Rate Select switch position). The smaller vernier marks on the knob represent 100Hz (or 10Hz) and the larger marks represent 1KHz (or 100Hz). One complete rotation of the tuning knob results in 10KHz (or 1KHz) frequency increase or decrease. When you receive your set, calibration of the tuning knob may be desirable, as the large increments may not correspond exactly to a change of 1KHz displayed on the readout. Exact calibration is not necessary as the displayed frequency will always be correct but you may calibrate the scale on the tuning knob for use as an analog type frequency display. To calibrate, set a large increment on the tuning scale to line up with the indicator arrow directly above the scale and then turn ON the power.

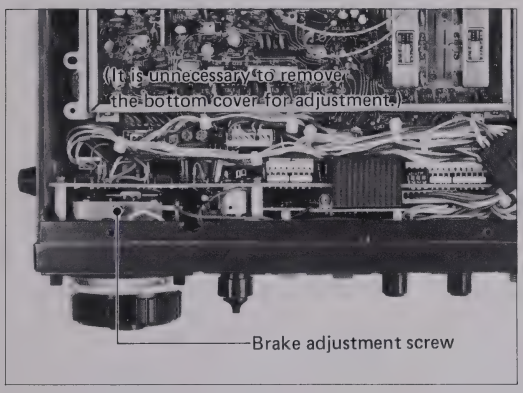
To calibrate the scale during operation, if desired, set the frequency readout to 0.0KHz, push the dial lock button,

then set the large increment on the tuning scale to line up with the indicator arrow and then push the dial lock button again.

The tuning knob scale may require recalibration if you:

1. Turn the knob while the frequency is locked by use of the Dial Lock Button.
2. Turn the knob beyond the band edge.

Brake Adjustment
If the knob is too loose or too stiff for comfortable use, you can adjust the torque by tightening or loosening the brake adjustment screw accessible from underneath the set.



The following instructions should be used to adjust the tension of the Tuning Knob.

1. The Tuning knob tension will become tighter by turning the brake adjustment screw clockwise, and will become looser by turning the screw counterclockwise.
2. While performing this adjustment, the Tuning knob must be turned continuously as the screw is adjusted in order to set the tension for a comfortable touch.

On all HAM bands except the 28MHz band, the displayed frequency will not go beyond the highest band edge even by turning the tuning knob clockwise, or beyond the lowest band edge by turning the knob counterclockwise. On the 28MHz band, since this band width is much wider than the others, the IC-720A provides "automatic revert" over either MHz for operating convenience. When the frequency display shows 28.999.9MHz and the tuning knob is turned clockwise, the displayed frequency jumps down to 28.000.0 MHz and continues up from there. Likewise, by continuing to turn counterclockwise beyond the bottom edge of the band, the frequency jumps up from 28.000.0MHz to 28.999.9MHz and goes down from that point. The same holds true for the 29MHz segment, and the general coverage mode.

The frequency range of each band in the HAM band mode is shown in the following chart.
In the GENERAL COVERAGE mode, the frequency range is ".000.0" to .999.9" of each MHz.

Band	Frequency Range
1.8	1.800.0 ~ 1.999.9
3.5	3.500.0 ~ 4.099.9
7.0	6.900.0 ~ 7.499.9
10.0	9.900.0 ~ 10.499.9
14.0	13.900.0 ~ 14.499.9
18.0	17.900.0 ~ 18.499.9
21.0	20.900.0 ~ 21.499.9
24.0	24.500.0 ~ 25.099.9
28.0	28.000.0 ~ 28.999.9
	29.000.0 ~ 29.999.9

The displayed frequency shows the carrier frequency in the USB, LSB, AM and CW modes, and the Mark frequency in the RTTY mode.

5-1-3 TUNING RATE SELECT SWITCH

Pushing the Tuning Rate Select switch will change the basic tuning rate of the set. In its normal out position the tuning rate is 100Hz. When pushed in the tuning rate becomes 10Hz. The 10Hz may be read from the increments on the tuning knob.

5-1-4 TUNING SPEED BUTTON

Pushing the Tuning Speed Button will illuminate the Dial TS Indicator and the tuning rate is changed to correspond to 1KHz steps. The last significant-digit on the display is blanked. When the Tuning Speed Button is depressed again, the Dial TS Indicator goes OFF and the tuning rate will again correspond to 100Hz (10Hz) steps. This button will allow you to quickly QSY over a great frequency range.

5-1-5 DIAL LOCK BUTTON

After the IC-720A is set at a certain frequency for rag chewing, mobile operation, etc., pushing the Dial Lock button will illuminate the Dial Lock Indicator and the VFO is locked at the displayed frequency, thus inactivating the operation of the tuning knob. To change the frequency, the Dial Lock must first be disengaged by pushing the Dial Lock button again. The Dial Lock Indicator will go OFF, and the frequency will change with the direction of the tuning knob rotation. Turning OFF the power will release the Dial Lock.

5-1-6 VFO SWITCH

The CPU in the IC-720A contains two "VFO's" for both receiving and transmitting. The VFO's are labeled "A" VFO and "B" VFO and are selectible with the VFO Switch. This dual VFO system gives the IC-720A many very convenient features. Please read this section very carefully and perform the operation several times until you are comfortable with the system.

1. "A" VFO is for both transmitting (ham bands only) and receiving and is selected by placing the VFO switch in the "A" position. The transmit and receive frequency will be controlled by "A" VFO, displayed on the frequency readout, and stored in "A" memory.

2. "B" VFO is for both transmitting (HAM bands only) and receiving and is selected by placing the VFO switch in the "B" position. The transmit and receive frequency will be controlled by "B" VFO, displayed on the frequency readout, and stored in "B" memory.

EXAMPLE:
When the set is turned ON, 7.100.0 will be displayed on the readout.
This will occur whether the VFO switch is in either the "A" or "B". Rotating the tuning knob clockwise will increase the frequency in 100Hz (10Hz) steps. Rotating the tuning knob counterclockwise will decrease the frequency in 100Hz (10Hz) steps.

■ Switching from one VFO to the other VFO does not clear the first VFO. The frequency is retained in VFO's memory.

EXAMPLE:
If 14.125.0MHz is set with "A" VFO, and the VFO switch is set to "B" VFO, the frequency readout will show "B" VFO's frequency, but 14.125.0MHz is still stored in "A" VFO's memory. Returning the VFO switch to "A" VFO position, and 14.125.0 will be displayed on the readout. Accordingly, if the switch is placed in the "B" VFO position, the frequency that was set with the "B" VFO will appear. This allows you to set a certain frequency with one VFO, work up and down the band with the other VFO, and periodically check the set frequency simply by switching between "A" and "B" VFO. It also allows you to search for a clear frequency with one VFO, while keeping your operating frequency on the other VFO. When you have found a clear frequency, switch back to your operating frequency, inform the station you are in contact with of the new frequency, and switch back. It's that simple!

■ The IC-720A will perform this operation even on two different bands. A frequency is set in either "A" or "B" VFO on one band, the VFO switch is set to the other VFO, and the band set to any other band you wish to work.

EXAMPLE:
Set "A" VFO to 14.255.0MHz. Set the VFO switch to "B" VFO. Switch to the 21MHz band. The frequency readout will read 21.100.0MHz. Operate anywhere you wish with "B" VFO. When you want to return to 14.255.0MHz, switch back to "A" VFO. The frequency readout will show 14.255.0MHz.

5-1-7 VFO EQUALIZING SWITCH
This switch allows either VFO's to be brought to the exact frequency of the other VFO without turning the tuning knob. Therefore, it is very easy to make a few KHz split transmit/receive frequencies.

EXAMPLE:
When "A" VFO is 14.255.5MHz and "B" VFO is 21.355.0 MHz, pushing the VFO Equalizing switch, "B" VFO's frequency becomes the same as "A" VFO's (14.255.5MHz). Now the "A" VFO's frequency is memorized in the "B" VFO, and you can operate anywhere with "A" VFO. When you want to return to the previous frequency (14.255.5 MHz), switch back to "B" VFO. It's very easy. Also, you can make several KHz split frequency operation with "A" VFO and "B" VFO, in a moment. To reverse this (A the same as B), push the Function Key first.

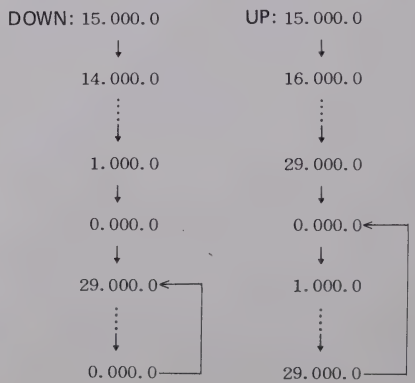
5-1-8 SIMPLEX/DUPLEX (TRANSCEIVE/SPLIT)
Pushing the Simplex/Duplex (Transceive/Split) switch will change the relationship of the two VFO's. In the SIMPLEX (out) position, one VFO is for both transmit and receive. In the DUPLEX (in) position, one VFO is for transmit and the other is for receive, so that this will allow you to operate split transmit/receive frequencies on the same band.

EXAMPLE:
Set "A" VFO to 7.085.0MHz and "B" VFO to 7.255.0 MHz.
Return the VFO Switch to "A" VFO then set the Simplex/Duplex Switch to the Duplex position. 7.085.0MHz will shown on the readout during receive ("A" VFO) and 7.255.0MHz during transmit ("B" VFO). You are now receiving on 7.085.0MHz and transmitting on 7.255.0MHz. Setting the VFO switch to "B" VFO to reverses the above.

5-1-9 HAM/GENERAL COVER SWITCH
This two position switch selects the range of frequencies to be covered by the Band Up/Down switches. In the HAM (out) position the frequencies available are those of the 9 amateur bands, between 1.8MHz and 28MHz. In the general coverage mode (in) the unit operates as a receiver in the range 0.1 to 30MHz with thirty 1MHz segments.

5-1-10 BAND UP/DOWN SWITCHES
These switches labeled UP and DOWN increment the radio one band at a time in the desired direction. When in the HAM band mode this switch will move the transceiver to the next band with each push. When in the General Coverage mode the band changes up or down in 1MHz segments. When the set reaches the highest band in either mode it will automatically return to the lowest band, or vice versa, as per the following charts.

In the GENERAL COVERAGE mode



In the HAM band mode

DOWN:	UP:
7.100.0	7.100.0
↓	↓
3.600.0	10.100.0
↓	↓
1.900.0	14.100.0
↓	↓
29.100.0	18.100.0
↓	↓
28.100.0	21.100.0
↓	↓
24.900.0	24.900.0
↓	↓
21.100.0	28.100.0
↓	↓
18.100.0	29.100.0
↓	↓
14.100.0	1.900.0
↓	↓
10.100.0	3.600.0

5-1-11 RIT (RECEIVE INCREMENTAL TUNING)

By using the RIT circuit, you can shift the receive frequency ±800Hz either side of the transmit frequency without moving the transmit frequency itself. Therefore, when you get a call slightly off frequency, or when the other station's frequency has shifted, you can tune in the frequency without disturbing the transmitting frequency. By pushing the RIT switch once the RIT circuit is turned ON and the RIT Indicator is lit.

The receive frequency is shifted with the RIT Control knob.

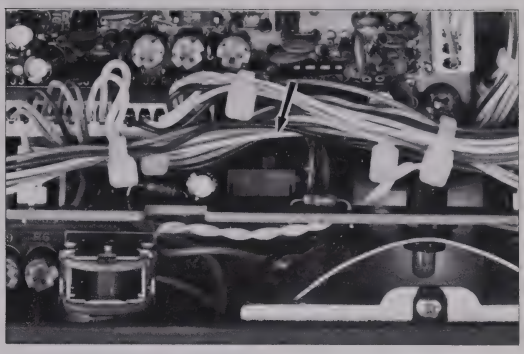
When the RIT Control knob is in the "0" position, the transmitting and receiving frequencies are the same.

Rotating the control to the (+) side raises the receiving frequency, and rotating to the (−) side lowers the frequency. To turn OFF the RIT control, again push the RIT switch and the RIT Indicator will go OFF. When the RIT circuit is OFF, the transmit and receive frequencies are the same regardless of the setting of the RIT control knob.

NOTE: The RIT circuit is operational when the frequency is locked with the dial lock button. The frequency shifted by turning the RIT control is not indicated on the frequency display. When the transmitting and receiving frequencies differ by more than 800Hz, use "A" and "B" VFOs.

When the RIT circuit is ON, if the tuning knob is moved by one increment, the RIT circuit is automatically pulsed OFF.

If you do not wish the RIT to pulse OFF automatically when the tuning knob is turned, the switch shown below will allow this function. If this is done it is important that the RIT be at the "0" position during tuning performed with the Tuning Knob.



5-2 SSB OPERATION (In HAM band mode)

5-2-1 RECEIVING:

After connecting an antenna, microphone, etc., set knobs and switches as follows.

POWER SWITCH	OFF (OUT)
HAM BAND/GENERAL COVER SELECT SWITCH	HAM (OUT)
T/R SWITCH	RECEIVE (OUT)
VOX SWITCH	OFF (OUT)
ATT SWITCH	OFF (OUT)
AGC SWITCH	SLOW (OUT)
NOISE BLANKER (NB) SWITCH	OFF (OUT)
VFO SWITCH	A (OUT)
AF GAIN CONTROL	Completely Counterclockwise
RF GAIN CONTROL	Completely Clockwise
P.B. TUNE CONTROL	OFF or Center (12 o'clock) position
RIT CONTROL	Center (12 o'clock) position

The other controls are unrelated to receiving and need not be set at this time.

Now turn ON the power switch. The meter lamp will be illuminated and [L a 7.1000] will be shown on the MODE/FREQUENCY display.

In SSB operation there is both an USB (upper side band) and an LSB (lower side band). LSB is usually used on the 1.8, 3.5 and 7MHz bands, while USB is usually used on the 10MHz band and above. The IC-720A selects the normally used sideband according to the band in which you are operating.

When you wish to operate on another band than the 7MHz band, push the BAND UP/DOWN switches to select the band you wish to operate.

Slowly turn the AF gain control clockwise to a comfortable level. Rotate the tuning knob until a signal is received. The multi-function meter needle will move according to the signal strength, so tune for the highest possible meter reading and the clearest audio. If you cannot get a clear signal,

you may be receiving in the opposite sideband. If so, change the mode to the proper sideband, by pushing the FUNCTION switch, then SSB switch.

5-2-2 NB (NOISE BLANKER)

Turn the noise blanker ON (in) when there is pulse type noise, such as ignition noise from automobile motors. Noise will be suppressed and even weak signals will be received comfortably. The noise blanker will effectively work for "woodpecker's noise", however, if the receiving signal is too strong, the noise blanker may work with the receiving signal itself, and some distortion may cause in the receiving audio or keying form. At this time, turn the noise blanker OFF.

5-2-3 AGC (AUTOMATIC GAIN CONTROL)

The IC-720A has a fast attack/slow release AGC system which holds the peak voltage of rectified IF signals from the IF amp circuit for a certain period. Therefore, during the pauses in normal speech of the received signal, uncomfortable noise will not be heard. The meter indicates the peak value for a certain period, facilitating reading of the meter "S" function.

For normal SSB reception, set the AGC switch in the OUT (slow) position. Set the AGC Switch in the FAST (IN) position, when tuning or receiving signals with short interval fading. When in the FAST position, the time constant is shortened.

5-2-4 ATT (ATTENUATOR) SWITCH

Turn the ATT switch ON (IN) when strong nearby signals disturb signal reception or make "S" reading difficult. In the ON position, the RF amplifier is removed from the circuit and a 10dB attenuator is inserted into the receiving antenna circuit, reducing interfering signals and giving more stable reception. In normal operation the ATT switch is left in the OFF (OUT) position.

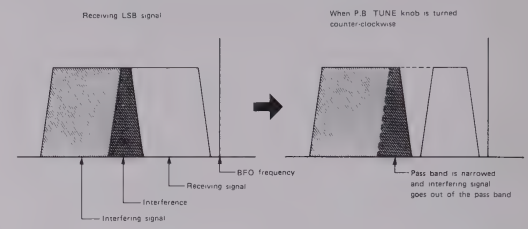
5-2-5 P.B. (PASS-BAND) TUNING

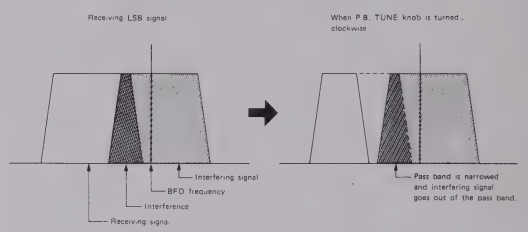
Pass-Band Tuning is a system in the receive mode to narrow the band width (selectivity) of the frequencies that will pass through the crystal filter electrically from either the upper or lower side continuously by up to 800Hz. This is very effective in reducing interference from nearby signals.

To use the PBT system, rotate the PBT control clockwise until it clicks on and continue rotating it to its mid range position. This is the widest position and is equivalent to the bandwidth in the OFF position.

For example, while receiving in the LSB mode, if you get interference from a lower frequency (interfering signals are high pitched tones), narrow the band width by turning the P.B. tuning control counterclockwise. When the interfering signals are low-pitched tones, they are from a higher frequency, and you should narrow the band width by turning the P.B. tuning control clockwise.

When receiving in the USB mode, the band width is narrowed in the opposite manner. Interference from a higher frequency will be high-pitched tones, and the P.B. tuning control should be turned clockwise. Interference from a lower frequency will be low-pitched tones and the P.B. tuning control is turned counterclockwise.


Receiving LSB signal
When P.B. TUNE knob is turned counter-clockwise
BFO frequency
Receiving signal
Interference
Interfering signal
Pass band is narrowed and interfering signal goes out of the pass band


Receiving LSB signal
When P.B. TUNE knob is turned clockwise
Interfering signal
BFO frequency
Interference
Receiving signal
Pass band is narrowed and interfering signal goes out of the pass band.

This control can also be used for audio tone adjustment, so it may be set for the most comfortable reception.

5-2-6 TRANSMITTING

Before transmitting, listen in the receive mode to make sure your transmission will not interfere with other communications. If possible, use a dummy load for adjustment instead of an antenna. Set knobs and switches as follows.

MIC GAIN	CENTER
RF POWER CONTROL	OFF (clockwise til it "clicks")
METER SELECT SWITCH	ALC

Other knobs and switches are left in the same positions as for receiving. When the T/R switch is moved to transmit, or when the PTT (push-to-talk) switch on the microphone is depressed, the TRANSMIT Indicator is illuminated. By speaking into the microphone, the meter needle will move according to the strength of your voice and SSB signals will be transmitted. Set the MIC GAIN control so that the meter needle stays well within the blue ALC zone at voice peaks. Change to the receive mode by moving the T/R switch to receive, or release the microphone PTT switch.

5-2-7 HOW TO USE THE SPEECH PROCESSOR

The Pass-Band Tuning system acts as a low distortion RF Speech Processor. This enables greater talk power and better results in DX operation. Follow the steps below for use of the RF Speech Processor:

MIC GAIN CONTROL	Set to the CENTER (12 o'clock) position.

RF POWER CONTROL Turn from the "COMP OFF" position until it "Click" ON.

Switch to transmit and turn the RF POWER CONTROL counterclockwise while speaking into the microphone until you obtain the desired RF "PEAK" output power of between 10 watts and 100 watts (approximately).

Adjust the MIC GAIN CONTROL to a point where the RF "AVERAGE" output power just saturates.

The Speech Processor should be turned OFF or MIC GAIN CONTROL carefully set for minimum compression for all communication other than DX operation for a very natural voice quality.

5-2-8 HOW TO USE THE VOX CIRCUIT

The IC-720A has a built-in VOX (voice operated relay) which allows automatic T/R switching by voice signals into the microphone. For VOX use, set the knobs inside the top access cover as follows:

VOX GAIN CONTROL
FULLY COUNTERCLOCKWISE
ANTI VOX CONTROL
FULLY COUNTERCLOCKWISE
VOX DELAY CONTROL
FULLY CLOCKWISE

Push the VOX switch on the front panel to the ON (in) position. Leaving the T/R switch in the RECEIVE position and without pushing the PTT switch, turn the VOX GAIN control clockwise while speaking into the microphone. At a certain point, the T/R switching circuit will be activated by your voice. This is the proper position for the VOX GAIN control. Set the VOX GAIN control at a level which provides for T/R switching at your normal voice level. Transmit-release time (the time delay before the set automatically returns to receive when you stop talking) is controlled by the VOX DELAY control. Turning the control counterclockwise makes the time shorter. Set it at a position which is comfortable and which allows for short pauses in normal speech.

Adjust the ANTI VOX control so that the VOX circuit is not activated by sounds from the speaker by turning the control clockwise while receiving a signal.

5-3 CW OPERATION

5-3-1 RECEIVING

For CW reception, push the MODE SELECT Switch for CW mode, or CW-N mode (first the FUNCTION key, then the CW switch).
Other switches and knobs are set the same as for SSB reception.

In addition to the crystal band pass filter, a Narrow filter (FL-32) is optional for this unit. When the MODE SELECT Switch is set at the CW-N mode, this filter is activated and the total selectivity of CW reception is improved (500Hz/−6dB). Also, with this filter, internal noise is reduced for comfortable CW reception and an improved signal to noise (S/N) ratio.

If the optional CW filter is not installed the CW-N mode will have the same selectivity as the CW mode.

The Pass Band Tuning system can be used to narrow the band width up to 800Hz, the same as in the SSB mode.

Also, use the Noise Blanker, AGC switch and/or ATT switch depending on the receiving conditions, the same as SSB reception.

5-3-2 TRANSMITTING

Insert the keyer plug into the KEY Jack on the rear panel of the unit, and set knobs and switches as follows:

RF POWER CONTROL OFF (Fully clockwise)
METER SELECT SWITCH RF POSITION

Other knobs and switches are set the same as for CW reception.

By setting the T/R switch to TRANSMIT, the TRANSMIT indicator is lit and shows that you are ready for CW transmission. When you key the keyer, the meter needle moves and your CW signal is transmitted. To decrease the transmitting power, turn the RF POWER Control counterclockwise to ON and rotate to adjust while watching the meter needle on the Po scale for the desired output power.

5-3-3 CW SIDE-TONE (MONITOR)

When keying the side-tone oscillator is activated and a 800Hz tone will be heard. The loudness of the tone is controlled by the CW MONI Control located under the top access cover. Rotating the control clockwise will increase the loudness. This tone is also audible in the receive mode and can be used for code practice, adjustment of the keyer, etc.

5-3-4 SEMI BREAK-IN OPERATION

The IC-720A has Semi Break-In CW capability when using the VOX function. When keying, the unit is automatically set in the transmit mode. After keying, it is returned to the receive mode, also automatically, after a given transmit-release delay time constant. Leave the T/R switch in the RECEIVE position, and set the VOX switch in the ON (IN) position.

The transmit release delay time constant is set by adjusting the CW DELAY Control located under the top access cover. Turning the CW DELAY Control clockwise will make the transmit release time longer. Set for your keying speed.

5-4 RTTY OPERATION

For RTTY operation, a teletypewriter and a demodulator (terminal unit) which is operational with audio input are required. Any demodulator with 2125/2295Hz filters (narrow, 170Hz shift) can be used with the IC-720A.

5-4-1 RECEIVING

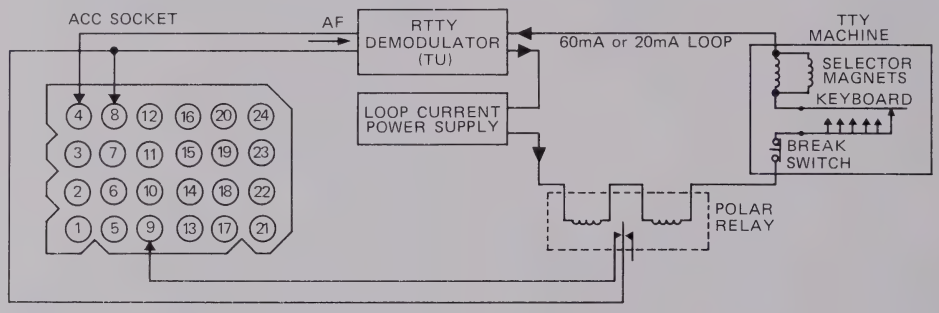
Audio signals for the demodulator can be supplied from Pin 4 of the ACC socket on the rear panel, or from the PHONES jack on the front panel. The level of the audio signals from Pin 4 of the ACC socket does not vary by turning the AF GAIN Control, and the level is about 300mV P-P maximum.

Set the operating mode for RTTY, by pushing the MODE SELECT switch "RTTY". The other controls are the same as those for SSB reception. When tuning a RTTY signal, set the TUNING RATE SELECT switch in the 10Hz position, and tune to get audio signals of 2125Hz for MARK and 2295Hz for SPACE. (Use the tuning indicator of the terminal unit for easy tuning.) Also turn the P.B. Tune control for clear reception.

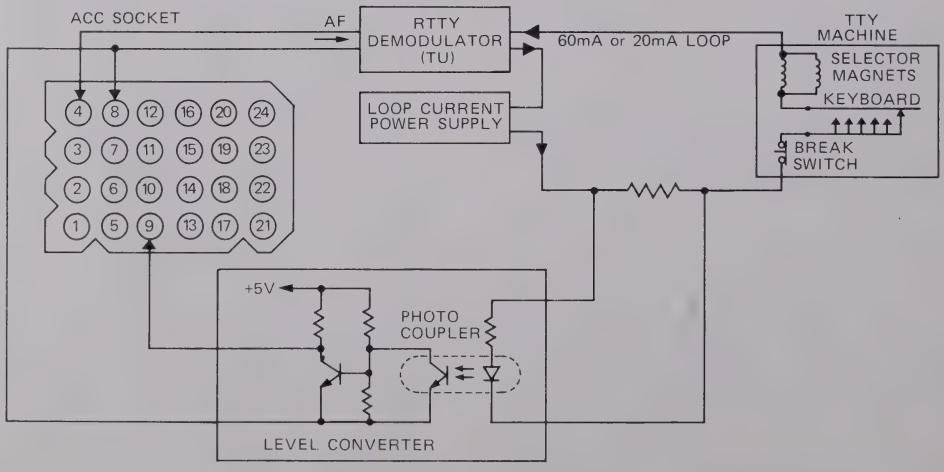
5-4-2 TRANSMITTING

For keying of the Frequency Shift Keying (FSK) circuit insert a high speed relay's coil into the loop current circuit of the teletypewriter, and connect the relay contacts to Pins, 8 and 9 of the ACC Socket on the rear panel. The relay contacts make during the Space and break during the Mark, as shown in the drawing. Fine adjustment of the MARK and SPACE frequencies can be done by adjusting the trimmer capacitors in the RTTY unit located next to the internal fan accessible through the bottom cover.

When a high speed relay is used



When a level converter is used

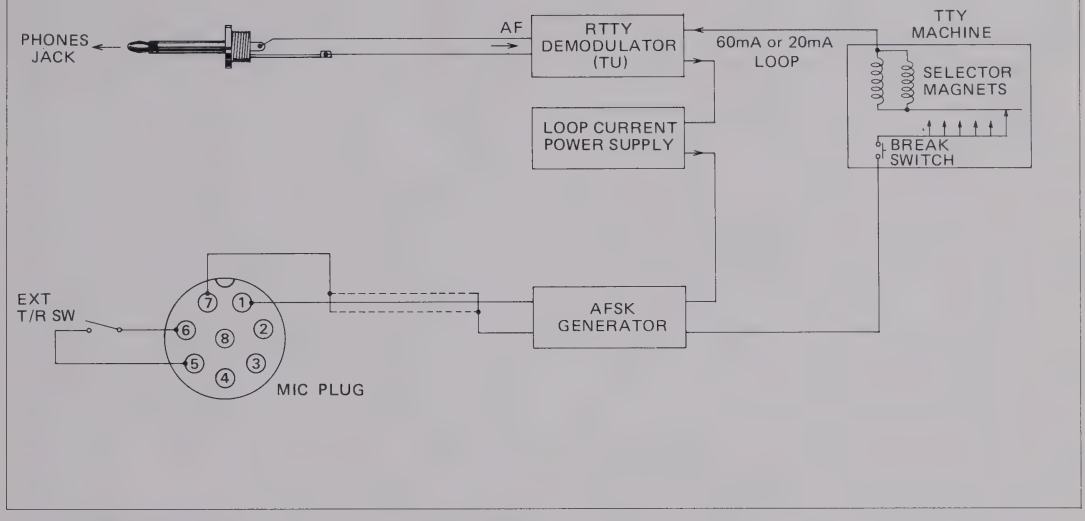


When a level converter for TTL level signals is used, connect the output of the converter to Pins 8 (ground) and 9 of the ACC Socket, apply High level (5V) signals for the Mark, and Low (0V) for the Space.

When using an AFSK generator that has 2125Hz for Mark and 2295Hz for Space, connect the output signals for the AFSK to the Mic connector on the front panel and set the Mode to LSB. (See Other Operations chapter.) Doing this, you can use the VOX operation available in this mode, and receive/transmit changeover is very easy.

If you wish to transmit continuously 10 minutes or more, reduce the output power to less than 70% of the full power, by rotating the RF POWER control on the front panel.

When an AFSK generator is used



5-5 AM OPERATION

5-5-1 RECEIVING

Set the operating mode for AM, by pushing the MODE SELECT switch "AM". The other controls are the same as those for SSB reception, except the Pass Band Tuning. The Pass Band Tuning control does not work when the optional crystal filter, FL-34, is not installed. The filter, FL-34 will provide good selectivity and Pass Band Tuning capability for AM reception. Refer to the installation instructions on page 30.

When tuning an AM signal, tune for maximum signal strength as indicated on the multi-function meter.

5-5-2 TRANSMITTING

Transmitting AM signals is essentially the same as SSB transmission.

Set knobs and switches the same as for SSB operation. The RF POWER control should be in fully clockwise (COMP OFF) position. The output power in this mode, is about 40 watts and cannot be reduced by rotating the RF POWER control. Also, the speech processor does not work.

When transmitting AM signals, the multi-function meter (in RF position) will indicate the carrier power, and the meter needle will move slightly according to your voice.

5-6 GENERAL COVERAGE RECEIVER

In this mode, the set does not transmit on any frequency, even if the frequency is on the HAM band.

Set knobs and switches as follows.

POWER SWITCH	OFF (OUT)
HAM/GENERAL COVER SELECT SWITCH	GENERAL COVER (IN)
T/R SWITCH	RECEIVE (OUT)
VOX SWITCH	OFF (OUT)
ATT SWITCH	OFF (OUT)
AGC SWITCH	SLOW (OUT)
NOISE BLANKER (NB) SWITCH	OFF (OUT)
VFO SWITCH	"A" (OUT)
AF GAIN CONTROL	Completely Counterclockwise
RF GAIN CONTROL	Completely Clockwise
P.B. TUNE CONTROL	OFF or Center (12 o'clock) position
RIT CONTROL	Center (12 o'clock) position

The other controls are unrelated and need not be set for this operation.

Now turn ON the power switch. The meter lamp will be illuminated and U3 15.000.0 will be shown on the

MODE/FREQUENCY display.

In SSB operation there is both an USB (upper side band) and an LSB (lower side band). USB is selected on the 10MHz band and above, and LSB on the 9MHz band and below, in the SSB-N setting. When you wish to operate on the opposite sideband, push the FUNCTION switch first, then SSB switch.

When you wish to operate on a band other than the 15MHz band, push the BAND UP/DOWN switches to select the band you wish to operate. Slowly turn the AF gain control clockwise to a comfortable level. Rotate the tuning knob until a signal is received. The multi-function meter needle will move according to the signal strength, so tune for the highest possible meter reading and the clearest audio.

Refer to 5 - 2 - 2 ~ 5 on page 16 for other functions, 5 - 3 - 1 on page 17 for CW reception, 5 - 4 - 1 on page 18 for RTTY reception, and 5 - 5 - 1 on page 19 for AM reception.

When you wish to receive on 1.599.9MHz and below, connect a low band antenna to the LOW BAND ANT terminal on the rear panel. Refer to 5 - 7 - 6 on page 21.

5 - 7 OTHER OPERATIONS

5 - 7 - 1 METER FUNCTIONS

The multi-function meter functions as an S-meter in the receive mode, and as the following in the transmit mode, depending on combinations of the METER SELECT switch on the front panel, and the METER and SWR switches under the access cover.

RF meter : Indicates the relative output power on the Po scale.
ALC meter : Indicates the ALC condition.
Ic meter : Indicates the collector current of the final transistors.
SWR meter : Indicates the VSWR of the load on the SWR scale.

The combinations of the switch positions for the meter functions are as per the following chart.

METER FUNCTION	METER SELECT SWITCH	SWR SWITCH	METER SWITCH
RF meter	RF	SWR SET	RF
ALC meter	ALC	—	—
Ic meter	RF	—	IC
SWR meter (calibrating)	RF	SWR SET	RF
SWR meter (measuring)	RF	SWR	RF

5 - 7 - 2 VSWR READING

The IC-720A has a built-in VSWR meter for checking antenna matching in order to avoid problems caused by VSWR. Set the METER SELECT switch and METER switch to the RF positions, and the SWR switch to the SWR SET position as shown in chart 5 - 7 - 1. Set the operating mode to RTTY, and push the TRANSMIT/RECEIVE switch to TRANSMIT.

Adjust the SWR SET control located under the access cover so that the meter needle points to "SET" on the meter scale. Set the SWR switch to the SWR position. With the switch in the SWR position, SWR reading can be seen on the meter. Although this unit is built to handle VSWR of up to 2:1, it is recommended that the antenna(s) be adjusted for the lowest possible VSWR. After taking the reading, return the switch to the SWR SET position. ALSO BE SURE THAT THE ANTENNA IMPEDANCE IS 50 OHMS OR THERE MAY NOT BE ANY OUTPUT. OTHERWISE THERE WILL BE DAMAGE TO THE TRANSCEIVER.

The final transistors used in the IC-720A are of good design and are protected to a reasonable extent by circuits incorporated in the set. These devices can be expected to have an indefinite lifetime since there are no cathodes to burn out. Under some conditions, however, they can be abused beyond tolerance and may have to be replaced.

When in doubt about antenna systems, use the lowest power setting possible to achieve meaningful readings. Use a good tuner or transmatch when necessary. Always use caution and exercise judgement when testing RF power generators.

5 - 7 - 3 WWV RECEPTION

To receive WWV (or other standard frequency station), set the operating band to 10MHz in the HAM band mode, and the MODE to any mode. Tune to 10.000.0MHz on the frequency display.

Since the IC-720A has a General Coverage receiver built-in, any frequency's WWV can be received. Merely set to the GENERAL COVERAGE mode and USB or CW, and tune to the desired frequency.

The WWV signal can be used for alignment of a frequency counter, marker oscillator, or the frequency display.

5 - 7 - 4 SIMPLE FREQUENCY ALIGNMENT

A very accurate frequency counter is necessary to align the frequency of the IC-720A. However, the frequency can be aligned simply by receiving the WWV signal.

1. Set the frequency display to 10.000.0MHz in the HAM band and be sure that you are receiving the WWV signal.
2. Set the operating mode to CW. A 800Hz beat can be heard.
3. Short the KEY Jack on the rear panel so that the CW sidetone also becomes audible.
4. Rotate the FREQUENCY SET Control, located under the access cover, so that the two tones are of the same pitch (in zero beat). If the tones are difficult to adjust

because of a difference in their strengths, adjust the CW sidetone level with the CW MONI control, also located under the access cover, until the strengths are the same.

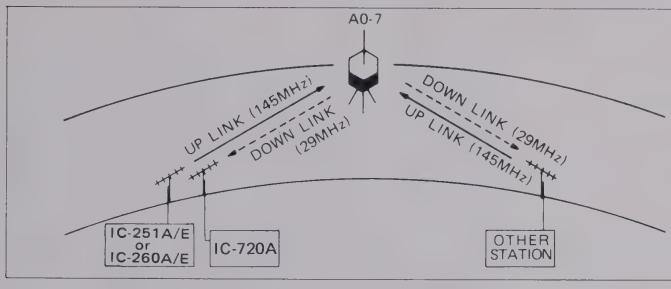
WHEN ALIGNING THE FREQUENCY, DO NOT PUT THE UNIT IN THE TRANSMIT MODE.

Be sure the T/R switch is in the Receive position, the VOX switch is OFF, and that you do not touch the PTT switch on the microphone.

5-7-5 SATELLITE COMMUNICATION

At present there are two active satellites for amatuer radio use, though more are being planned. AMSAT OSCAR 7 was launched in November, 1974, and AMSAT OSCAR 8 was launched in March, 1978. Satellite communications can be made by using an IC-251A/E or IC-260A/E for transmitting and the IC-720A for receiving. For operation, and frequency information, refer to the chart below.

Since communication satellites are moving at very high speeds, the down-link signals can be heard on a higher frequency than the real frequency as a satellite approaches, and on a lower frequency as it travels further away. Further information on communicating through satellites can be found in various amateur radio books and periodicals.



AO-7 · AO-8 FREQUENCY CHART

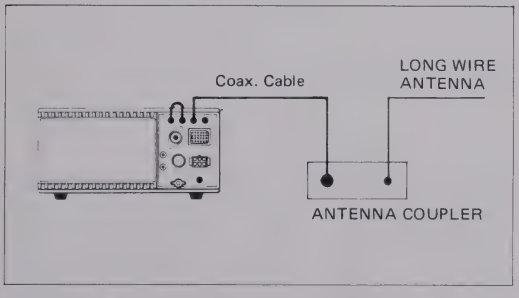
MODE A	
UP LINK FREQUENCY	DOWN LINK FREQUENCY
145.85MHz	29.4MHz
145.95MHz	29.5MHz

BEACON FREQUENCY

AO-7	29.502MHz
AO-8	29.402MHz

5-7-6 LOW BAND ANTENNA

A single wire can be used for receiving BC signals, connecting it to the LOW BAND ANT terminal. However, this may not be efficient for good reception. So, make an antenna as long as and as high as possible, and use an antenna tuner to convert its impedance to 50ohms. The connection is shown below.



5-7-7 RECEIVE ANTENNA TERMINALS

The RECEIVE ANT IN jack is connected to the input terminal of the receiving section, and the RECEIVE ANT OUT jack is connected to the antenna connector through the internal T/R antenna switching circuit.

These two jacks are normally jumpered with a cable, but can be used for:

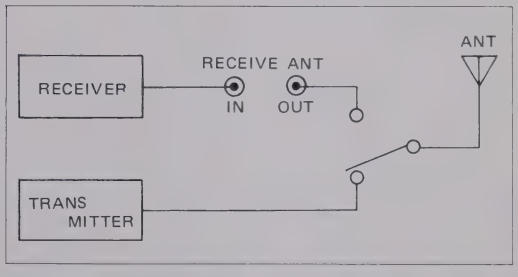


Fig. 1 Connection of a pre-amplifier

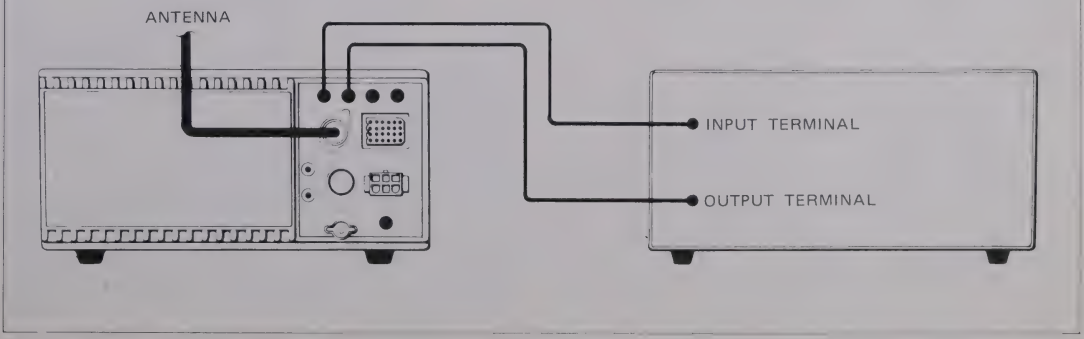


Fig. 2 Connection of a separate receiver (After changing the internal socket)

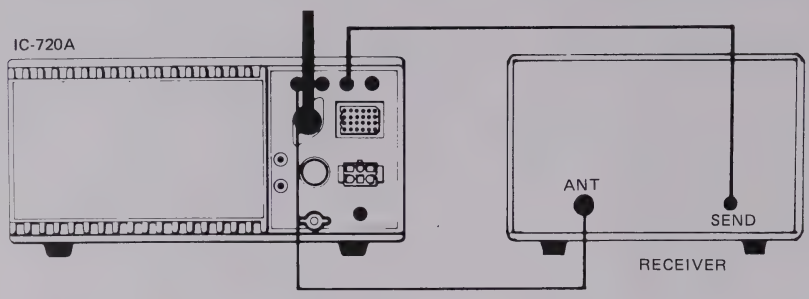
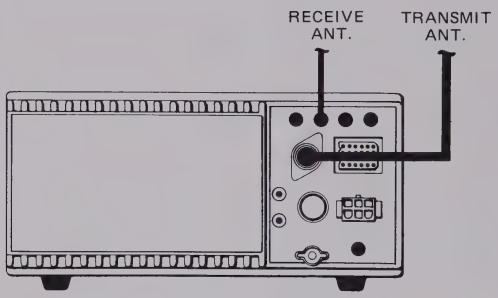


Fig. 3 Connection of separate antennas



1. A receiving pre-amplifier. (Fig. 1)
2. A separate receiver. (Fig. 2)
3. Separate receiver and transmitter antennas. (Fig. 3)

If you wish to use a receiver pre-amplifier, connect it between the receiver input and antenna output terminals.

If a separate receiver is used, connect it to the receiver antenna output terminal. For a separate receive antenna connect it to the receiver input terminal.

5-7-8 TRANSVERTER CONNECTION

The TRANSVERTER SCOPE (ALC) terminal can be used for a VHF/UHF transverter INPUT/OUTPUT terminal.
The transverter's input/output frequency and signal level should be as follows:

Transverter INPUT/OUTPUT Frequency

Operating Band	Input/Output Frequency
50MHz	20 ~ 24MHz
144MHz	24 ~ 26MHz
430MHz	20 ~ 30MHz

- Input/Output Level
  Transmit (Output) : Max. 150mV across a 50 ohm load
  Receive (Input) : 1μV for S/N 10dB

Also, apply transverter mode control signals to Pin 10 and 11 of the ACCESSORY socket as shown below.

In the transverter mode, the frequency display shows 1MHz digit to 100Hz digit.

Transverter mode control signals:

TRV A (Pin 10)	TRV B (Pin 11)	BAND
L	H	50MHz
H	L	144MHz
H	H	430MHz
L	L	OFF

H = +5V L = 0V

5-7-9 SCOPE TERMINAL

Also, the TRANSVERTER SCOPE (ALC) terminal can be used for a scope terminal (It puts out 39.7MHz IF signals of the 1st mixer stage.) by changing internal connections.

The following is the procedure for changing internal con-

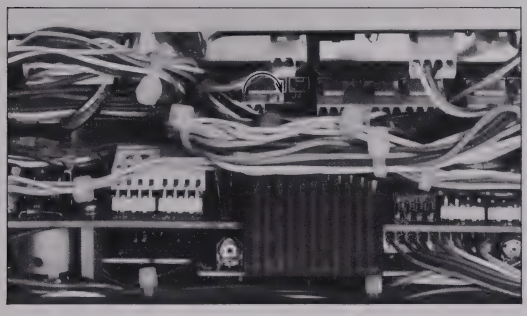
nections: Before performing any work on the set, make sure that the power cord is detached from the transceiver.

1. Remove the bottom cover.

2. Remove the four screws at each end of the IF Unit. Tilt the unit back toward you, being careful not to damage the sockets and plugs that are installed on the IF Unit.

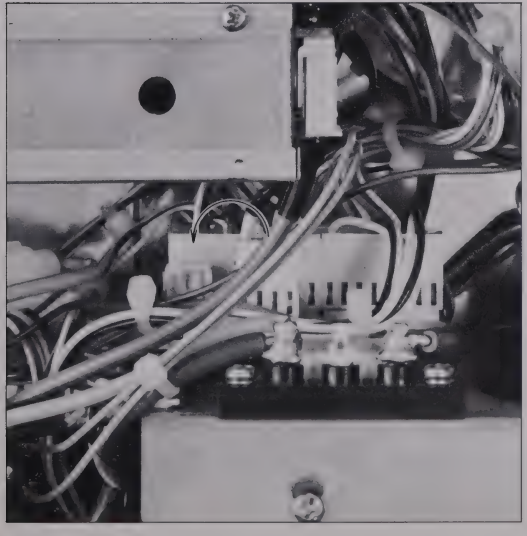
3. Change the 2 Pin plug inserted in J1, 4 Pin jack, of the RF unit, to the right side of J1 (the next 2 Pins to the previous ones) as shown.

4. Carefully replace the IF unit and the bottom cover.

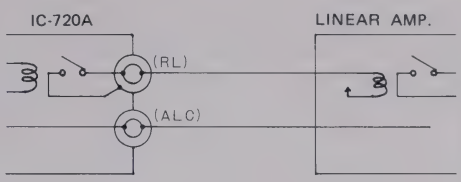


5-7-10 LINEAR AMPLIFIER CONNECTION

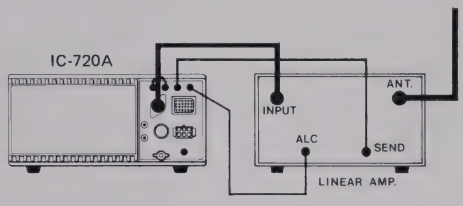
The jacks on the rear panel marked Low Band ANT (RL) and X-verter/Scope (ALC) are dual function, running from these two jacks on the interior of the set are wires which are connected to Plug P11. When this plug is connected to J12 scope and transverter functions are available, when connected to J13 there is a relay built-in for keying a linear, and the input for ALC from the linear. For linear amplifier hookup the RL Jack is for an internal relay and the ALC Jack is for ALC input.



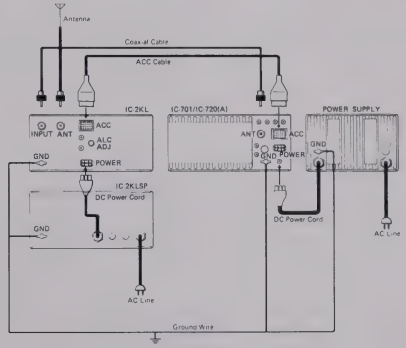
Internal Connections for Linear Amplifier



Cable Connections of a Linear Amplifier



Cable Connections for IC-2KL



The IC-720A puts out the band control voltage to change operating band automatically for external equipment such as linear amplifier and antenna tuner. The voltage is put out from Pin 13 of the accessory socket. (Refer to page 11.)

Band Control Voltage Chart

BAND (MHz)	Band Control Voltage
1.8	7.0 ~ 8.0V
3.5	6.0 ~ 6.5V
7	5.0 ~ 5.5V
14	4.0 ~ 4.5V
18 - 21	3.0 ~ 3.5V
24 - 28	2.0 ~ 2.5V
10	0 ~ 1.2V

The IC-720A uses a phase-locked-loop (PLL) consisting of three loops for the local oscillator for both transmit and receive. The PLL is controlled by a Microcomputer system. The basic circuit uses an up-conversion with a First IF of 39.7315MHz and a Second IF of 9.0115MHz. Included within the IF Unit is the Pass Band Tuning circuit. Altogether there are 11 units in the IC-720A, with overall control exercised by the Logic Unit. The units are:

6-1 SWR UNIT

This unit consists of a VSWR detecting circuit, an RF amplifier circuit, and an attenuator circuit.

When a signal is received by the antenna it passes through the SWR Unit and is fed into the Low-Pass Filter, then again sent to the SWR Unit, then amplified by a wide-band amplifier about 10dB. This amplifier uses push-pull of junction FET's, 2SK125's, to achieve low noise and wide dynamic range.

When the Attenuator is turned ON, the signal bypasses the RF amplifier and goes directly to the Attenuator Circuit and is attenuated 20dB.

During transmit, signals passed through the Low-Pass Filter unit, are applied to this unit, and detected for forward power and reflected power, then are fed to the antenna terminal.

6-2 LOW-PASS FILTER UNIT

The Low-Pass Filter Unit has a low-pass filter for each band, a rotary relay switching circuit, and a diode matrix which takes the signal from the Logic Unit and processes it for the relay control voltage. During receive, the signal from the SWR Unit passes through the Low-Pass Filter Unit which switches for the proper band eliminating the undesired signals from out-of-band, and then is sent again to the SWR Unit. During transmit, the output signal from the PA Unit is fed to the Low-Pass Filter of the proper band and eliminates all harmonic components, then is fed to the SWR Unit.

6-3 RF UNIT

Composed of a Band-Pass Filter for each band, 1st Mixer, 2nd Mixer, 1st IF, and Noise Blanker. During receive the Logic Unit sends the appropriate signal to the Band-Pass Filter which chooses the suitable pass band signal, then is fed to the 1st Mixer, which is a double balanced mixer (DBM), where it is mixed with the 1st Local Oscillator signal from the PLL, becoming a 39MHz signal, passes through the monolithic filter and is sent to the 2nd Mixer after amplification. In the 2nd mixer, also a DBM, the signal is mixed with the signal of the 2nd Local Oscillator from the PLL Unit and a 9MHz signal is obtained, again amplified, and sent to the IF Unit. The circuit for the Noise Blanker consists of a noise amplifier, a noise detector and a monostable multivibrator which blocks the IF Amplifier when noise is present.

In transmit the 9MHz signal from the IF Unit is mixed with the signal of the 2nd Mixer, then the 1st Mixer, the reverse of receive, then to the Band-Pass Filter, a Double Balanced Mixer especially developed by ICOM which has an 18dBm intercept point.

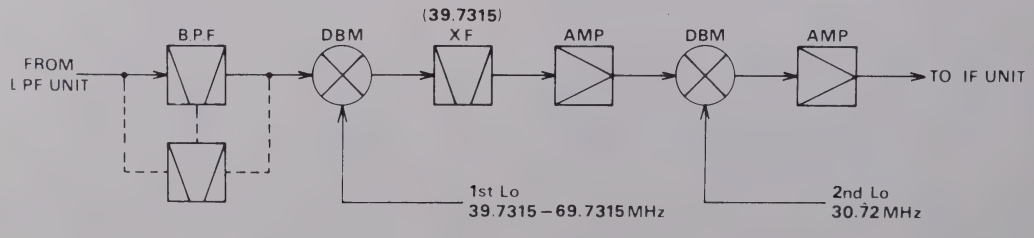
The figure below shows the Block Diagram of the RF Unit.

6-4 IF UNIT

Composed of a crystal filter for both SSB and AM, and an optional Narrow CW Filter, IF Amplifier, Pass Band Tuning circuit, RF Speech Processor, BFO, and the SSB, AM Detectors. During receive, the signal from the RF Unit is fed to the crystal filter, to the IF Amplifier, then to the Pass Band Tuning circuit composed of a DBM (as shown in the preceding figure), a crystal filter, and the VXO circuit. When the P.B.T. is turned ON the VXO frequency can be changed ±1.5KHz. The circuit makes a choice of what frequencies will pass electrically through the crystal filter.

The PBT will operate in all modes except AM. When the optional AM filter (FL-34) is installed the PBT will function in that mode. When the PBT is turned ON the signal is sent

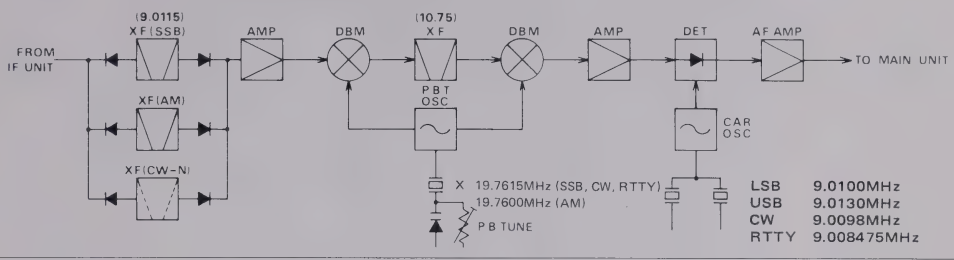
RF UNIT BLOCK DIAGRAM (Arrow shows the signal path in Receive)



to a second DBM then to the product detector, then to the Main Unit AF Amplifier. In the case of AM, the signal goes to the AM Detector Circuit, then to the Main Unit AF Amp. In SSB Transmit (USB or LSB) the audio signal and BFO signal go to the DBM where a double sideband signal is produced, then to the SSB Filter where USB or LSB is selected.

During CW or AM transmit the BFO signal is sent directly to the RF Unit, thus the BFO signal is used as a carrier signal.

IF UNIT BLOCK DIAGRAM (Arrow shows the signal path in Receive)



6-5 MAIN UNIT

Composed of the AF Amplifier, MIC Amplifier, VOX Circuit, Anti-VOX Circuit, CW Break-in Circuit, CW Monitor, ALC, APC, Regulator Circuit, and the Meter Control Circuit.

In receive, the detected AF signal from the IF unit, is applied to a high performance and low distortion AF power amplifier IC, and amplified and fed to the speaker.

In VOX operation, a part of the AF output signal is applied to the ANTI VOX circuit, and its output voltage is fed to the VOX circuit to prevent misfunction of the VOX by audio from the speaker.

In the CW mode, the side-tone oscillator is keyed according to your keying, and its output signal is fed to the AF power amplifier.

A voice signal from the microphone is applied to the MIC amplifier, amplified and fed to the modulation circuit on the IF unit.

The IC-720A has a protection circuit which detects reflected power, collector current of the final transistors, and ALC condition.

If some problem occurs, such as mismatching of the antenna, the circuit reduces the driving power to the final power transistors, and protects them.

6-6 DRIVER UNIT

The transmit signal from the RF Unit is amplified to 6 Watts in the Driver Unit, which is composed of three stages of wideband amplifiers.

6-7 PA UNIT

This unit is made up of a class AB push-pull wideband amplifier, a negative feedback circuit for giving a gain flatness response across the bands, and a thermal switch that monitors the temperature of the final transistors and controls the speed of the cooling fan. The signal from the Driver unit is applied this unit and amplified to 100 watts.

6-8 LOGIC UNIT

This unit is composed of an incorporated CPU for treating data such as up/down signal detection control, the dial lock control circuit, the speed tuning circuit, the rotary relay control circuit, code converter circuit, and the I/O control circuit.

The dial clock signals are generated by the photo-chopper directly connected to the tuning knob. The up/down control circuit detects the rotating direction of the tuning knob, and puts out the up/down control signal for the CPU.

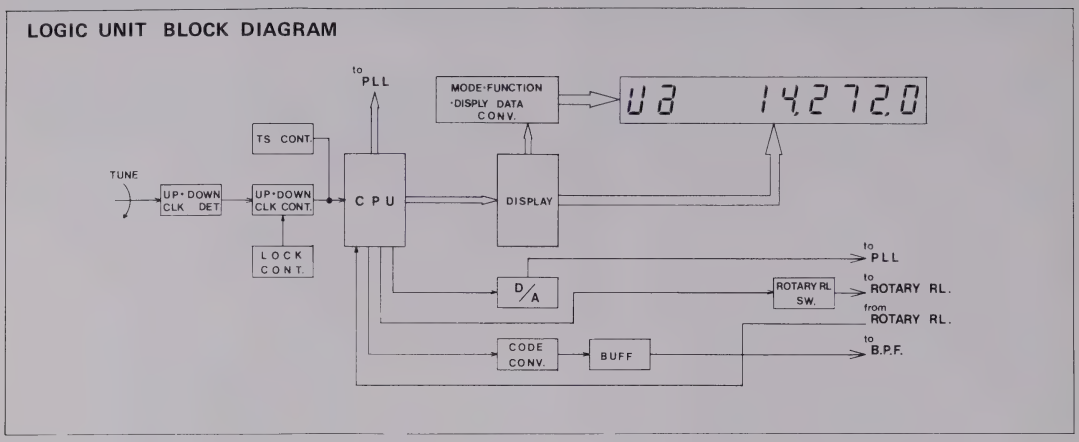
The CPU is a 4-bit microcomputer which has a program to control the set. The CPU's function are determined by the input signals, such as the dial clock signal, up/down signal and the signals from the function switches, and the CPU puts out signals to control the operating band, frequency, mode, tuning steps, display, and so on.

6-9 PLL UNIT

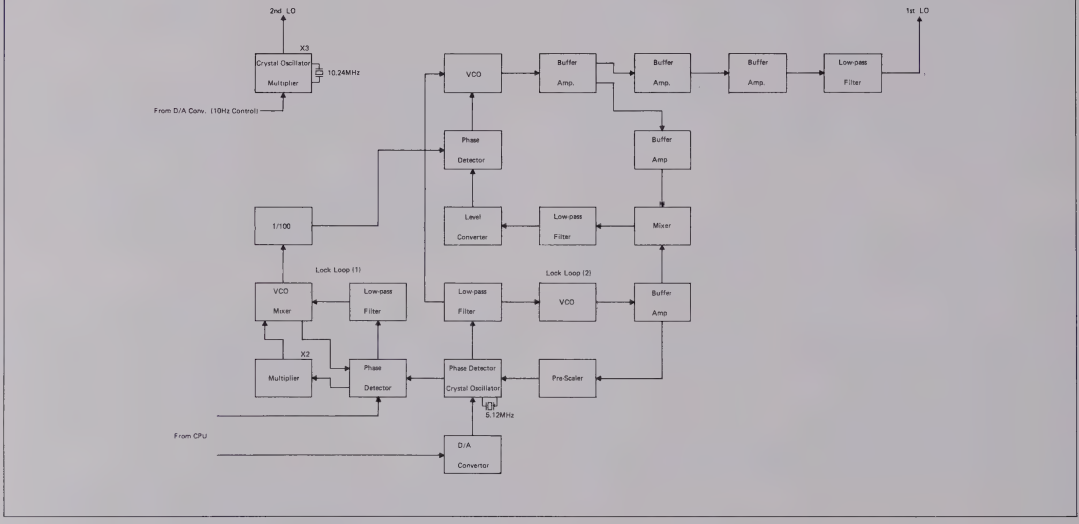
This unit is composed of three Phase-Locked Loops for the 1st Local Oscillator, a crystal oscillator and multiplier for the 2nd Local Oscillator, and voltage regulators for this unit.

The first loop puts out 13.15 ~ 23.14MHz with 10KHz steps.

LOGIC UNIT BLOCK DIAGRAM



PLL UNIT BLOCK DIAGRAM



This output signal is divided by 100 (131.5KHz ~ 231.4 KHz) and used for the reference frequency of the main loop. Thus, this loop provides 100Hz steps on the operating frequency.

The second loop puts out 39.6 ~ 69.6MHz with 100KHz steps. This output signal is used for the local oscillator of the main loop, and mixes down the VCO frequency to 131.5 ~ 231.4KHz.

The third loop, i.e., the main loop, puts out 39.7315 ~ 69.8314MHz, as the 1st Local Oscillator, with 100Hz steps, for the entire band.

The crystal oscillator is a VXO (Variable Xtal Oscillator), and provides 10Hz steps. This output is multiplied by 3 and puts out 30.72MHz for the 2nd Local Oscillator.

6 - 10 RTTY UNIT

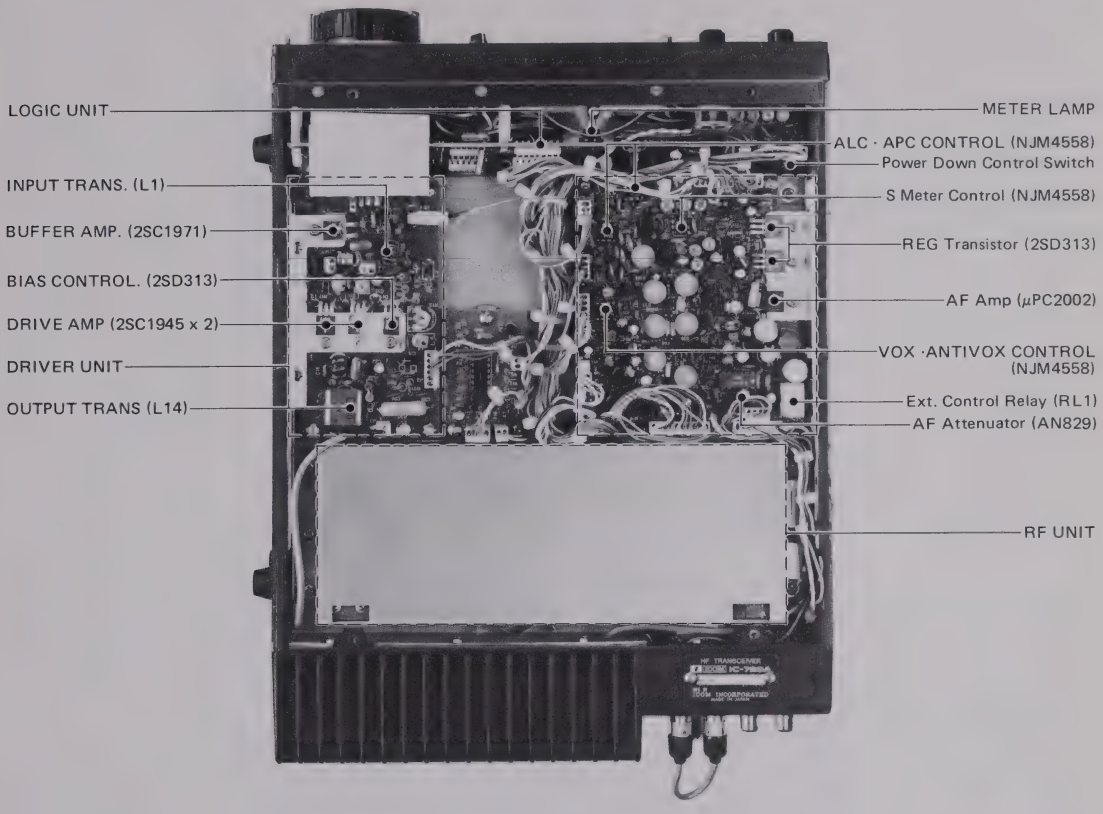
In transmit, this unit provides the FSK (Frequency Shift Keying) signals for RTTY. The crystal oscillator generates 9.0106MHz for the MARK and 9.01077MHz for the SPACE. These signals are sent directly to the 2nd mixer of the RF unit, and mixed with the 2nd Local Oscillator 30.72MHz, and puts out 39.7315MHz IF signals.

6 - 11 LDA UNIT

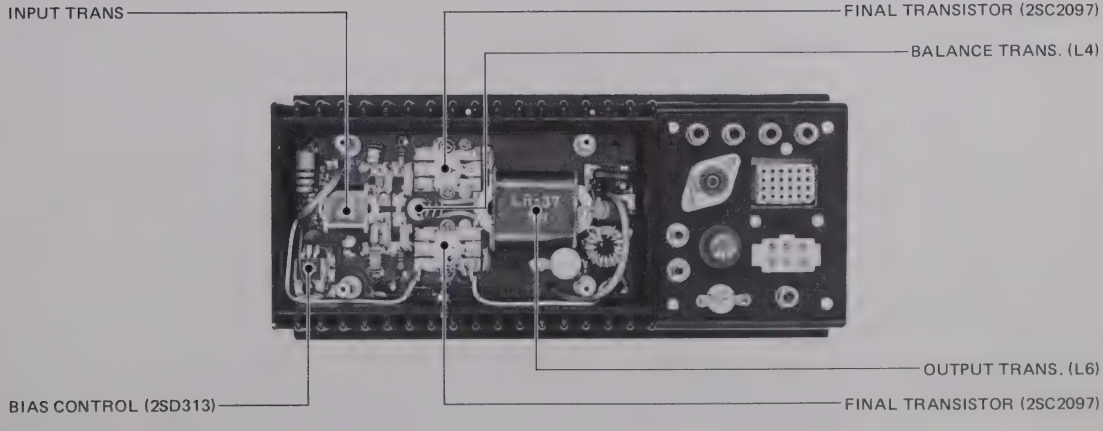
This unit converts the digital band signals which are put out from the CPU, to analog band control signals for external control such as the IC-2KL, linear amplifier.

SECTION 7 INSIDE VIEWS

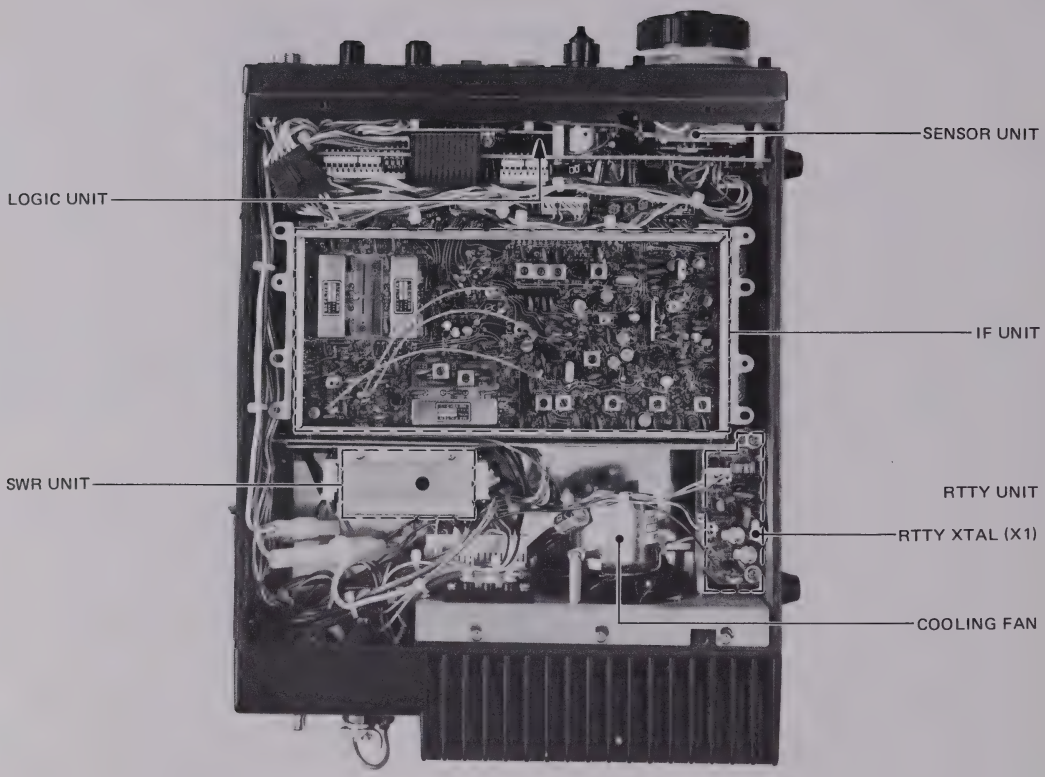
7-1 TOP VIEW



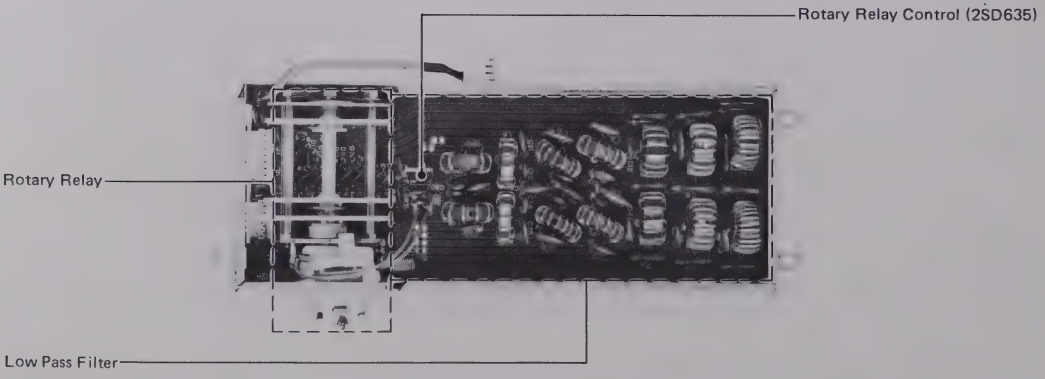
7-2 PA UNIT



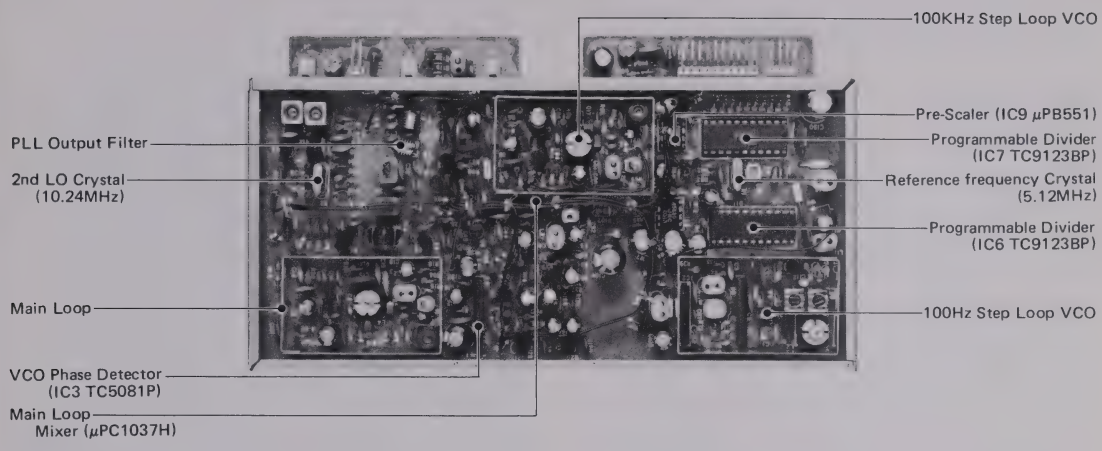
7-3 BOTTOM VIEW



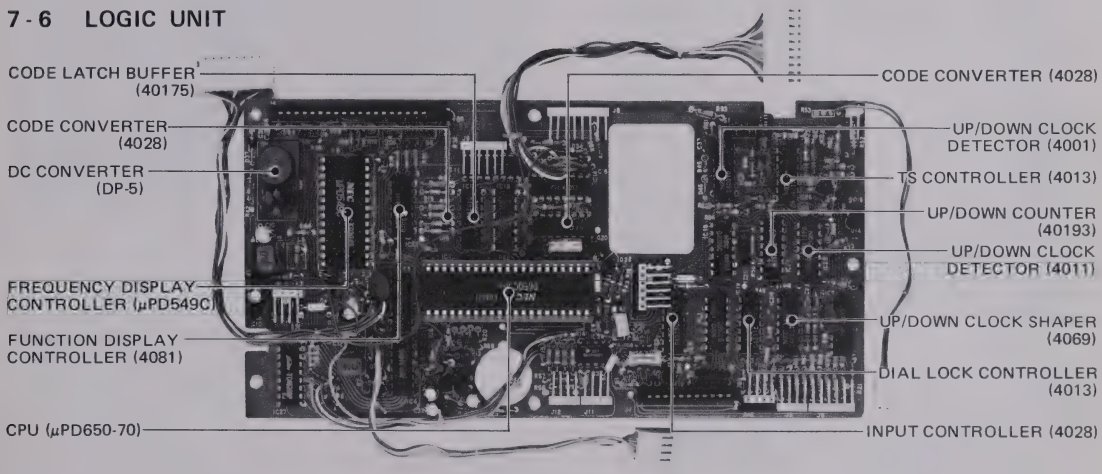
7-4 LPF UNIT



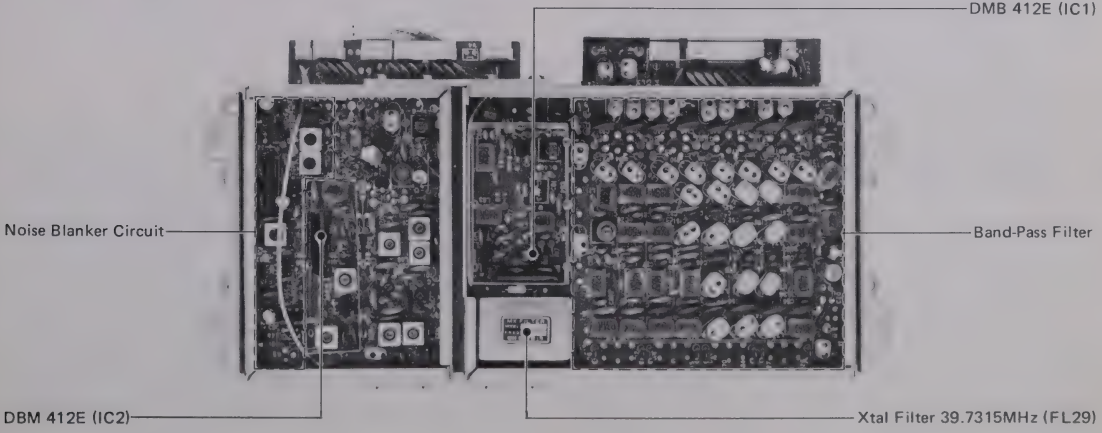
7-5 PLL UNIT



7-6 LOGIC UNIT



7-7 RF UNIT



8-1 INSTALLATION OF CW NARROW FILTER

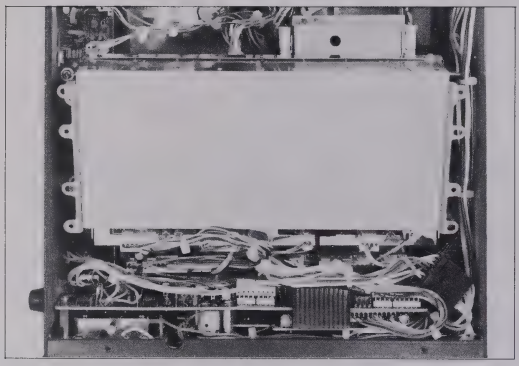
The following tools are needed for the installation of the options:

Phillips Screwdriver	Diagonal cutters
Screwdriver	Soldering Iron (40W)
Solder	Soldering tool
De-soldering braid	

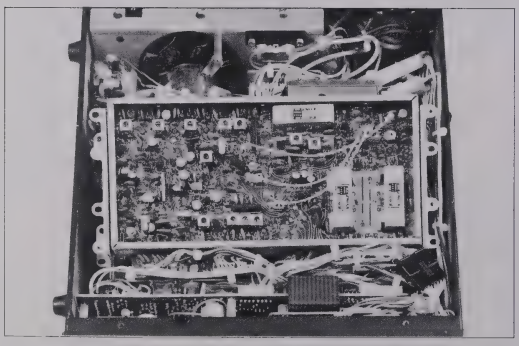
Before performing any work on the set, make sure that the power cord is detached from the transceiver.

1. Remove the bottom cover.

2. Remove the four screws at each end of the IF Unit (see photo). Tilt the unit back toward you, being careful not to damage the sockets and plugs that are installed on the IF Unit.

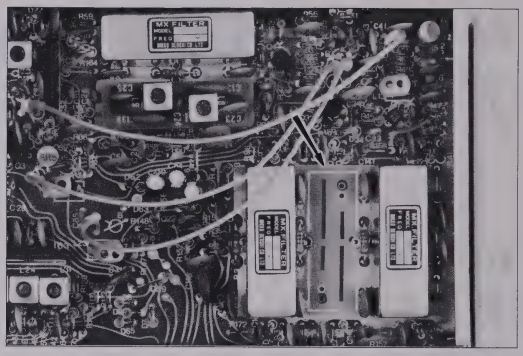


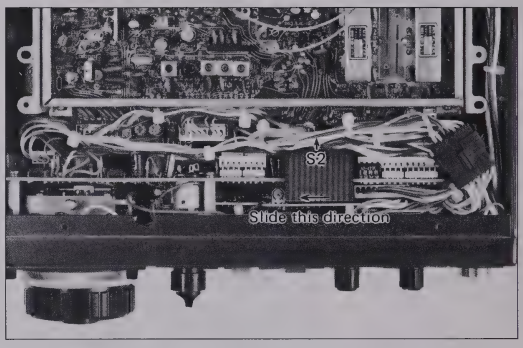
3. Using the screwdriver pry the cover of the IF Unit off, exercise care to prevent bending the shield cover.



4. The location for the filter is shown in the photo. The holes for mounting the legs and the leads of the filter are predrilled. Be sure to orient the filter so that the label on the top of the unit is facing the same direction as the other two filters already mounted in the set. Insert the filter flush with the board, bend the leads and legs flush with the opposite side of the board and solder them in. Trim the leads even with the solder points. This completes the installation. Replace the IF Unit, and the screws. Move Switch S2 in the direction shown. Replace the bottom cover.

Location of CW Narrow Filter



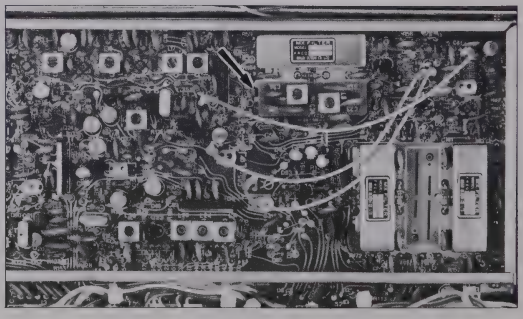


8-2 INSTALLATION OF AM FILTER

Follow steps 1 through 3 of the CW Narrow Filter instructions. Remove the LC Filter sub board, taking care not to damage the printed patterns of the board. The holes must be clear of solder when this sub board is removed.

Plug the AM Filter into the board, making sure that it is oriented with the label on the top of the filter matching the label on the adjoining filter. Bend the legs and leads flush with the board, solder them in, and trim the leads flush with the solder points. This completes the installation. Replace the IF Unit, the screws, and the bottom cover.

Location of LC Filter



This set has been completely adjusted and checked at the factory so no adjustment should be necessary. However, during prolonged use, the preadjusted oscillating frequency, etc. may need slight adjustment. If this becomes necessary, the following procedures should be followed. As the adjustments other than those specified herein require high skill and expensive equipment, for best results the set should be sent back to the dealer or ICOM service center for adjustment.

9-1 MEASURING INSTRUMENTS REQUIRED FOR ADJUSTMENT

(1) FREQUENCY COUNTER
- FREQUENCY RANGE 0.1 - 90MHz
- ACCURACY BETTER THAN ±1 ppm
- SENSITIVITY 100mV or BETTER

(2) SIGNAL GENERATOR
- FREQUENCY RANGE 0.1MHz - 40MHz
- OUTPUT VOLTAGE –20 - 90dB (0dB = 1μV)

(3) MULTIMETER 50KΩ/Volt or better

(4) AC MILLIVOLTMETER
- MEASURING RANGE 100mV - 2V

(5) RF VOLTMETER
- FREQUENCY RANGE 0.1 - 80MHz
- MEASURING RANGE 0.1 - 10V

(6) RF WATTMETER (Terminated Type)
- MEASURING RANGE 20 - 100 Watts
- FREQUENCY RANGE 1.8 - 30MHz
- IMPEDANCE 50 OHMS
- SWR LESS THAN 1.1

(7) AF OSCILLATOR
- OUTPUT FREQUENCY 200 - 3000Hz
- OUTPUT VOLTAGE 0 - 100mV
- DISTORTION LESS THAN 0.1%

(8) OSCILLOSCOPE SYNCROSCOPE

(9) DIGITAL VOLTMETER
- MEASURING RANGE 0.001–10V 3-1/2 DIGITS

9-2 RECEIVER ADJUSTMENT

9-2-1 BFO FREQUENCY ADJUSTMENT

The BFO oscillator frequencies differ in accordance with each mode and for transmitting and receiving operation. Adjust corresponding trimmer capacitors and coil cores as shown in the table below. Connect the input terminals of the frequency counter through a 470 ohm resistor across the check point at R109 and ground of the IF Unit.

(a) Place the set in receive. Make frequency adjustments as follows.

RECEIVE OPERATION

MODE	ADJUSTING POINT	BFO OUTPUT FREQUENCY
USB	C97	9.01300 MHz (*)
LSB	L30	9.01000 MHz (*)
CW (CW-N)	L24	9.00980 MHz
RTTY	L31	9.008475MHz

(b) Turn ON the speech processor (COMP) and the knob fully counterclockwise to supress RF power from being transmitted. Then place the set in the transmit mode.

DO NOT KEY DOWN!

MODE	ADJUSTING POINT	BFO OUTPUT FREQUENCY
CW (CW-N)	L25	9.0106MHz

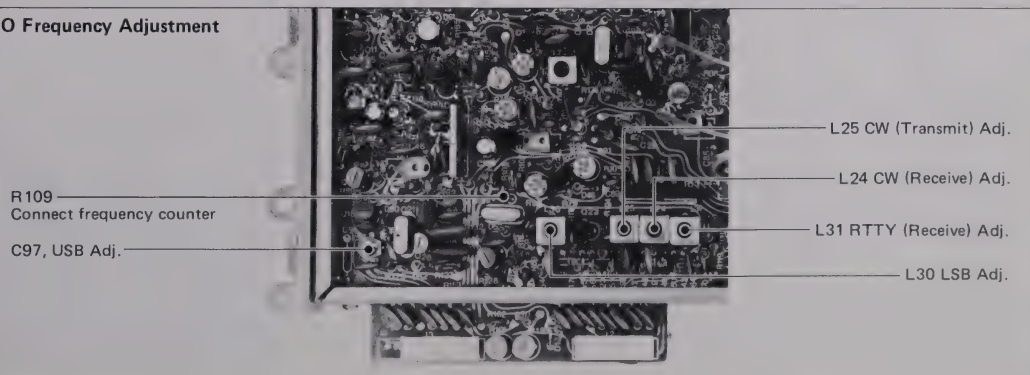
These adjustments interact and if difficulty is encountered, go back to LSB.

***NOTE:**
Fine adjustment for the SSB carrier point should be performed in accordance with adjustment "9 - 3 - 4", CARRIER POINT ADJUSTMENT, in the transmitter section adjustment procedures.

(c) Connect the RF wattmeter to the antenna connector. Connect a counter directly to the collector of Q3 on the RTTY unit, and place the set in transmit in the RTTY. Ground J1 for SPACE.

MODE	ADJUSTING POINT	BFO OUTPUT FREQUENCY
RTTY (SPACE)	C3 (RTTY unit)	9,01077MHz
RTTY (MARK)	C2 (RTTY unit)	9.01060MHz

BFO Frequency Adjustment



9-2-2 P.B.T. FREQUENCY ADJUSTMENT

Connect the input terminals of the frequency counter across the check point at R24 and ground of the IF Unit, and perform the following adjustments.

(a) Turn R19 fully counterclockwise.

(b) Place the set in receive in the USB or LSB, and turn the P.B.TUNE Control fully clockwise. Adjust coil L7 for a frequency of 19.7633MHz.

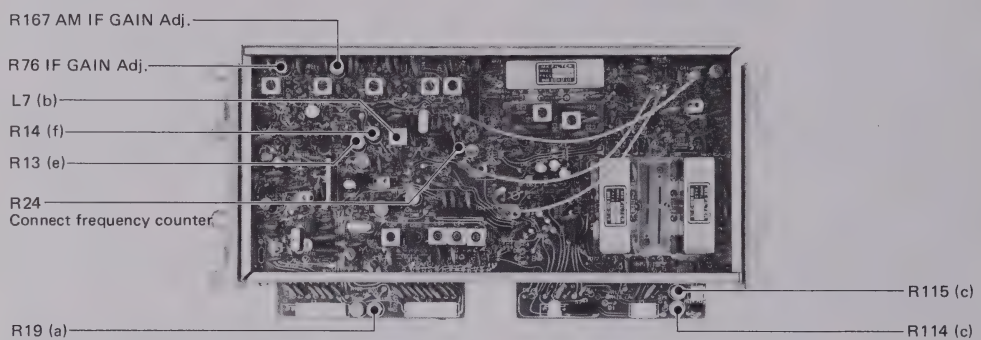
(c) Turn the P.B.T. control fully counterclockwise (just before click OFF), and set the mode to AM. Adjust R115 for 19.7567MHz, then set the mode to USB or LSB, and adjust R114 for 19.7597MHz.

(d) Set the P.B.T. control to the center position. If previous adjustments are correct, frequency should read 19.7615MHz (±200Hz) in USB or LSB, and 19.7600MHz (±500Hz) in AM.

(e) Connect the RF wattmeter to the antenna connector. Place the set in transmit in USB or LSB. Turn the RF POWER control fully counterclockwise (just before click OFF), and adjust R13 for 19.7615MHz.

(f) Place the set in receive in AM. Turn the P.B.T. control fully counterclockwise and click OFF. Adjust R14 for 19.7600MHz.

P.B.T. Frequency and IF Gain Adjustment



9-2-3 RECEIVER IF GAIN ADJUSTMENT

With the receive frequency set to 14MHz, mode to USB, AGC fast, RF GAIN fully clockwise, P.B.T. in the center position, connect the signal generator to the antenna connector. MAKE SURE THAT THE SET IS IN THE RECEIVE MODE! IF NOT, THE GENERATOR WILL BE DAMAGED!

(a) Adjust the signal generator frequency to the receive frequency (so that a beat note is heard) and set the signal generator output to 20dBμ, and adjust the AF GAIN control to obtain about 2 volts for 0dB reference on the AC millivoltmeter connected across the speaker.

(b) Turn off the signal generator output and the AC millivoltmeter reading should drop 30dB. If not 30dB, adjust R76 in the IF unit to reach that.

(c) When the optional AM Filter is installed adjust R167 in the IF unit to obtain equal audio output from the receiver (or S-meter reading) with the P.B.T. OFF and with it ON and centered.

9-2-4 S-METER ADJUSTMENT

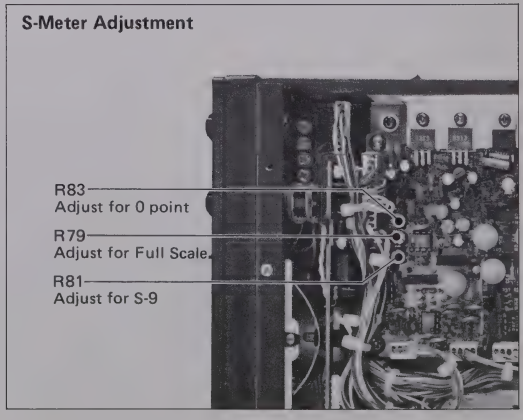
Set controls and connect the signal generator the same as 9-2-3.

(a) Turn off the signal generator output, and adjust R83 on the MAIN unit to indicate the "0" point on the scale.

(b) Adjust the signal generator frequency to the receive frequency and set the output to 62dBμ, and adjust R79 for full scale.

(c) Decrease the signal generator output to 22dBμ, and adjust R81 for S-9.

S-Meter Adjustment



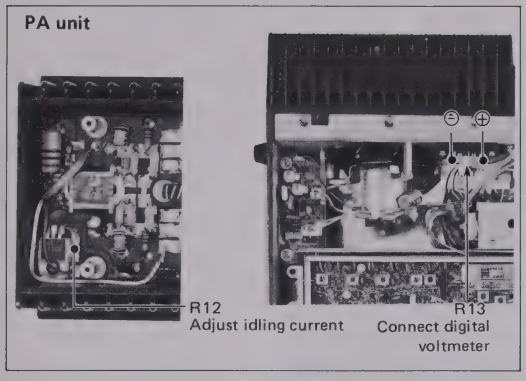
9-3 TRANSMITTER ADJUSTMENT

First, connect an RF wattmeter (impedance of 50 ohms) to the antenna connector.

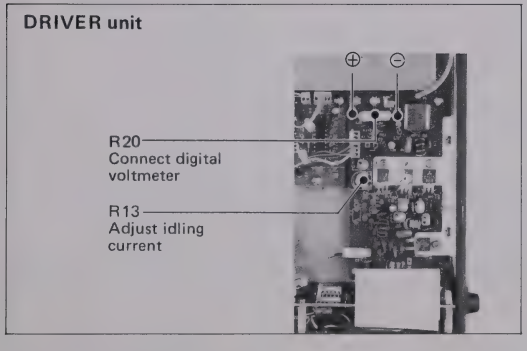
9-3-1 IDLING CURRENT ADJUSTMENT

Place the set in the transmit mode in USB or LSB, 14MHz band, the RF POWER and the MIC GAIN controls fully counterclockwise.

(a) Connect a digital voltmeter, in the 10 millivolt range, across R13 next to the cooling fan. Adjust R12 in the PA unit to obtain 7 millivolts on the meter. This makes 600mA idling current of the PA transistors.



(b) Connect a digital voltmeter, in the 100 millivolt range, across R20 in the DRIVER unit. Adjust R13 in the DRIVER unit to obtain 30 millivolts on the meter. This makes 100mA idling current of the driver transistors.



9-3-2 ALC (RF POWER) ADJUSTMENT

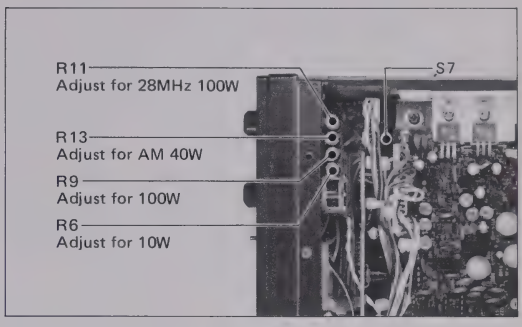
Place the set in the transmit mode in RTTY, 14MHz band, the RF POWER control fully clockwise (just before click OFF), and S7 on the MIC GAIN board in HI position.

(a) Adjust R9 on the MIC GAIN board for 100 ~ 110 watts output.

(b) Turn the RF POWER control fully counterclockwise, and adjust R6 on the MIC GAIN board for 5 ~ 10 watts output.

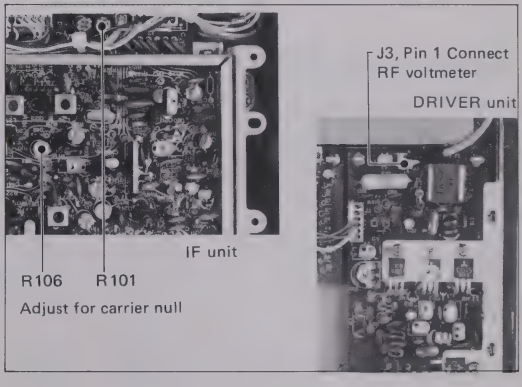
(c) Set the mode to AM, and turn the RF POWER control fully clockwise and click OFF. Adjust R13 on the MIC GAIN board for 35 ~ 45 watts output.

(d) Set the band to 28MHz and the mode to RTTY. Adjust R11 on the MIC GAIN board for 100 ~ 110 watts output.



9-3-3 CARRIER SUPPRESSION ADJUSTMENT

Place the set in the transmit mode in USB or LSB, 14MHz band, the RF POWER and the MIC GAIN controls fully counterclockwise. Connect an RF voltmeter (set to a high voltage scale) across Pin 1 of J3 in the DRIVER unit and ground. With an appropriate meter range to have suitable deflection for reading, adjust R101 and R106 in the IF unit for minimum in both USB and LSB modes.



9-3-4 CARRIER POINT ADJUSTMENT

Place the set in transmit in USB at 14MHz and turn the RF POWER control fully clockwise and click OFF (COMP OFF), and the MIC GAIN control in the center (12 o'clock) position. Connect the AF oscillator across Pin 1 (input) and Pin 7 (ground), of the mic connector.

(a) Set the frequency of the AF oscillator to 270Hz and the output at a level that gives approximately 20 watts output on the RF wattmeter.

(b) Then vary the AF oscillator frequency to 2700Hz and adjust C97 in the IF unit to obtain 20 watts on the meter.

(c) Performing the adjustments shown in (b) will affect the adjustment done in (a). Repeat adjustments in (a) and (b) until no difference is present.

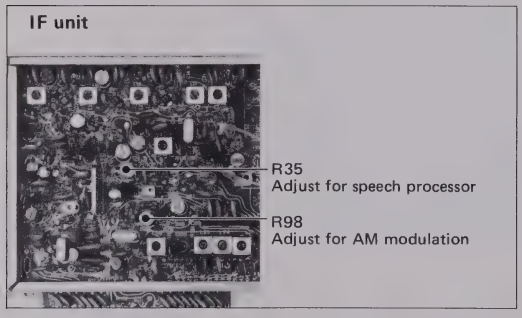
(d) Change the MODE to LSB and adjust L30 the same as the adjustments done in (a), (b) and (c) using L30. (Refer to 9 - 2 - 1 on page 31.)

9 - 3 - 5 SPEECH PROCESSOR ADJUSTMENT

Place the set in transmit in USB at 14MHz and turn the RF POWER control fully clockwise and click OFF (COMP OFF), and the MIC GAIN control in the center (12 o'clock) position. Connect the AF oscillator across Pin 1 (input) and Pin 7 (ground), of the mic connector.

(a) Set the frequency of the AF oscillator to 270Hz and the output at a level that gives approximately 20 watts output on the wattmeter. Adjust R13 in the IF unit so that both USB and LSB give equal output power. (Refer to 9 - 2 - 2 on page 32.)

(b) Set the frequency of the AF oscillator to 1500Hz and the output at a level that gives approximately 20 watts output on the wattmeter. Set the RF POWER control to MAX position (click ON), and reduce the output level of the AF oscillator 20dB (The output voltage is one tenth of the previous one.).
Adjust R35 in the IF unit to obtain 20 watts output on the wattmeter.



9 - 3 - 6 AM MODULATION ADJUSTMENT

Place the set in transmit in AM at 14MHz and turn the RF POWER control fully clockwise and click OFF (COMP OFF), and the MIC GAIN control in the center (12 o'clock) position. Connect the AF oscillator across Pin 1 (input) and Pin 7 (ground), of the mic connector.
Set the frequency of the AF oscillator to 1500Hz and the output at 100 millivolts.

Connect an oscilloscope to monitor RF output.

Adjust R98 in the IF unit for 100% modulation.

9 - 3 - 7 IC METER ADJUSTMENT

Connect a key to the key jack on the rear panel. Place the set in the transmit mode in CW at 14MHz band, and turn the RF POWER control fully counterclockwise.

Set the METER SELECT switch on the front panel, in the RF (out) position, and the METER switch (S2) in the MAIN unit in the IC position.

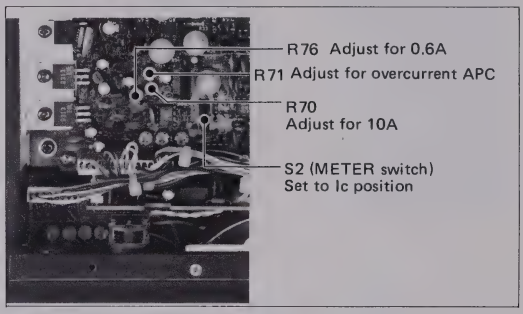
Connect a digital voltmeter, in 500 millivolt range, across R13 next to the cooling fan. (Refer to 9 - 3 - 1 on page 33.)

(a) With no power output, adjust R76 in the MAIN unit for 0.6A on the Ic scale of the multi-function meter.

(b) With key down, turn the RF POWER control clockwise to obtain 120 millivolts on the digital voltmeter.

Adjust R70 in the MAIN unit for a current reading of 10A.

(c) Repeat (a) and (b) to obtain 0.6A and 10A readings.



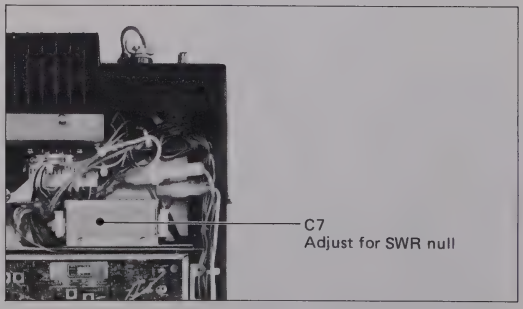
9 - 3 - 8 OVERCURRENT APC ADJUSTMENT

Place the set in the transmit mode in RTTY, and turn the RF POWER control fully clockwise. Find the band with the greatest Ic.

Adjust R71 in the MAIN unit until the point that the output power begins to drop. Back off R71 slightly.

9 - 3 - 9 SWR METER ADJUSTMENT

Place the set in transmit mode in RTTY, at 14MHz and turn the RF POWER control fully clockwise.
Set the METER SELECT switch, the METER switch and the SWR switch for SWR reading.
(Refer to 5 - 7 - 2 on page 20.)
Adjust C7 in the SWR unit for minimum SWR reading with a 50 ohm dummy load (or wattmeter).



ICOM AMERICA, INC.
2380 - 116th Ave. N.E., Bellevue, Washington 98004
Phone: (206) 454-7619 Telex: 152210
FAX: (206) 454-1509

SERVICE WORK ORDER

TAG NUMBER	DATE RECEIVED	BOX NUMBER
46041	3/23/90	
UNIT	**SERIAL NUMBER**	
720A	1483	

CUSTOMER

JAMES JOHNSON
Q657 SR.65 R.5
NAPOLEON, OH 43545

ACCESSORIES: NONE

WARRANTY STATUS: (NON) LF OR S1 S2

PHYSICAL CONDITION: V / V

METHOD RECEIVED: UPS

SPECIAL INST.:

PROBLEM: ☐ SEE NOTE ATTACHED
M/C

SERVICE WORK DONE ☑ Problem Confirmed ☐ Unable to Duplicate Date: 3/29/90 By: 900
Replaced driver Transistors

PERFORMANCE TESTING / QC

HF/VHF/UHF: xmit pwr. 100 w., rcvr FM sens _____
for 12dB SINAD; rcvr SSB sens 0.2 uV/14dB s+n/n

☐ frequency ☐ lights ☐ Rx audio ☐ squelch sens
☐ programming ☐ tracking ☐ pwr. adjust ☐ s-meter
☐ c-meter ☐ readout ☐ RIT ☐ APC ☐ AGC
☐ ALC ☐ mode switch ☐ scanning ☐ deviation

HF ONLY: ☐ band switching ☐ passband tuning
power (W) _____ @ 1.8, _____ @ 3.5, _____ @ 7.0, _____ @ 10.0, _____ @ 14.0, _____ @ 18.0, _____ @ 21.0, _____ @ 24.0, _____ @ 28.0

Other:

QUANTITY	MODULE NUMBER	PART DESCRIPTION	SYMBOL	FAILURE MODE	PRICE EACH	AMOUNT
2		2SC1945			@13.19	

SHIPPING STATUS: Date 3/30/90 Service Approval V 3/30/90 ☐ Note Special Instructions

Method of Shipment: ☐ COD ☐ Prepaid (UPS) ☐ Hand ☐ PP ☐ Other

1.0 hrs. @ $55.00 /hr.

SVC CODE: 10 40 05

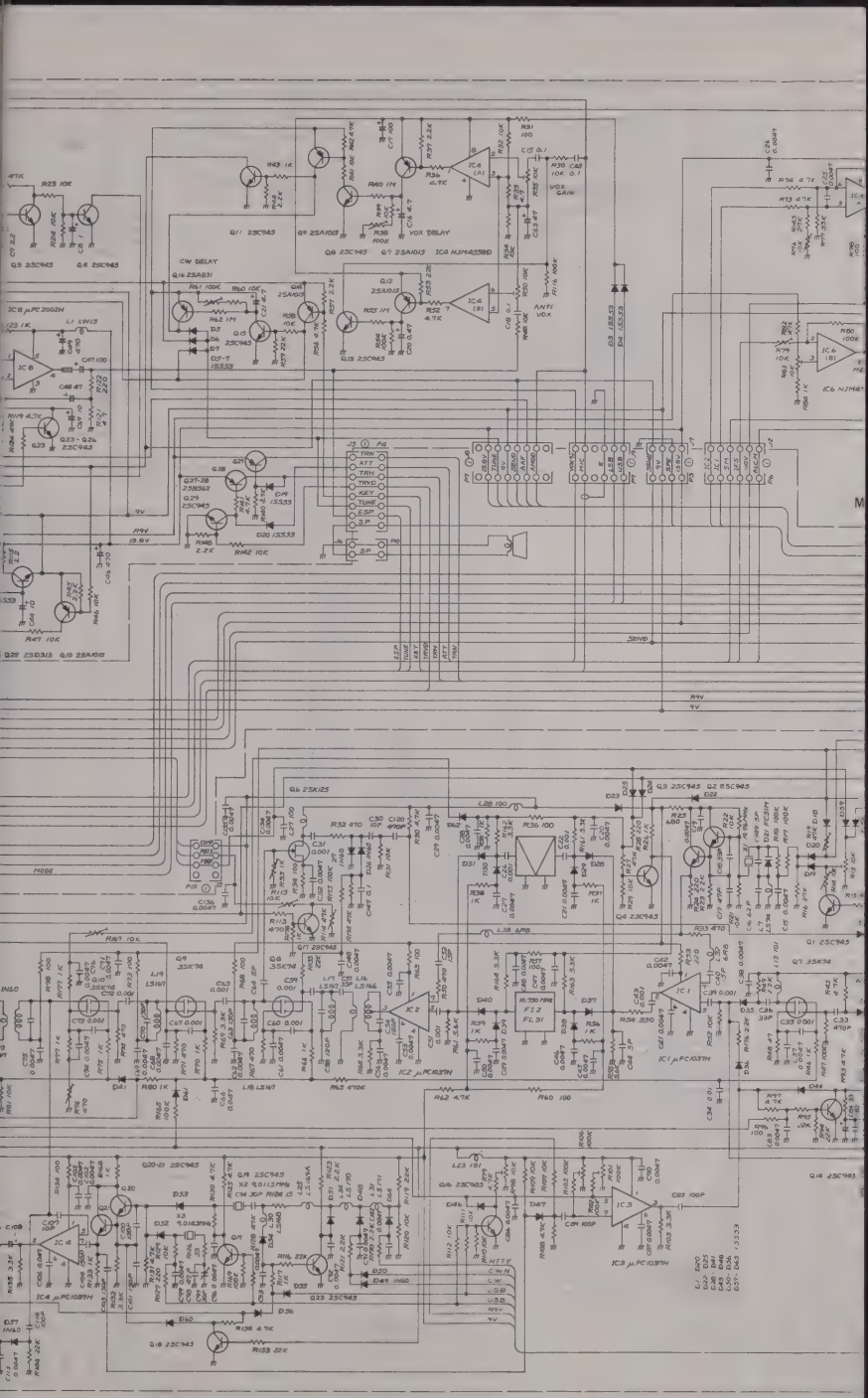
PARTS	13.19
LABOR	55.00
TAX	
FREIGHT	10.93
PREPAID	
TOTAL	79.12

RETAIN THIS RECORD — The service performed as described hereon is warranted for a period of thirty days from the date of return.
ICOM service facilities do not retain service work order files. A copy of this record must be included with your equipment to secure repair under this warranty.

Service Work Performed at:
☑ 2380 - 116th Ave. N.E., Bellevue, Washington 98004 (206) 454-7619
☐ 1777 Phoenix Parkway, Suite 201, Atlanta, GA 30349 (404) 991-6166
☐ 3071 #5 Road, Unit #9, Richmond, BC V6X 2T4, CANADA (604) 273-7400
☐ 3150 Premier Drive, Suite 126, Irving, TX 75063 (214) 550-7525

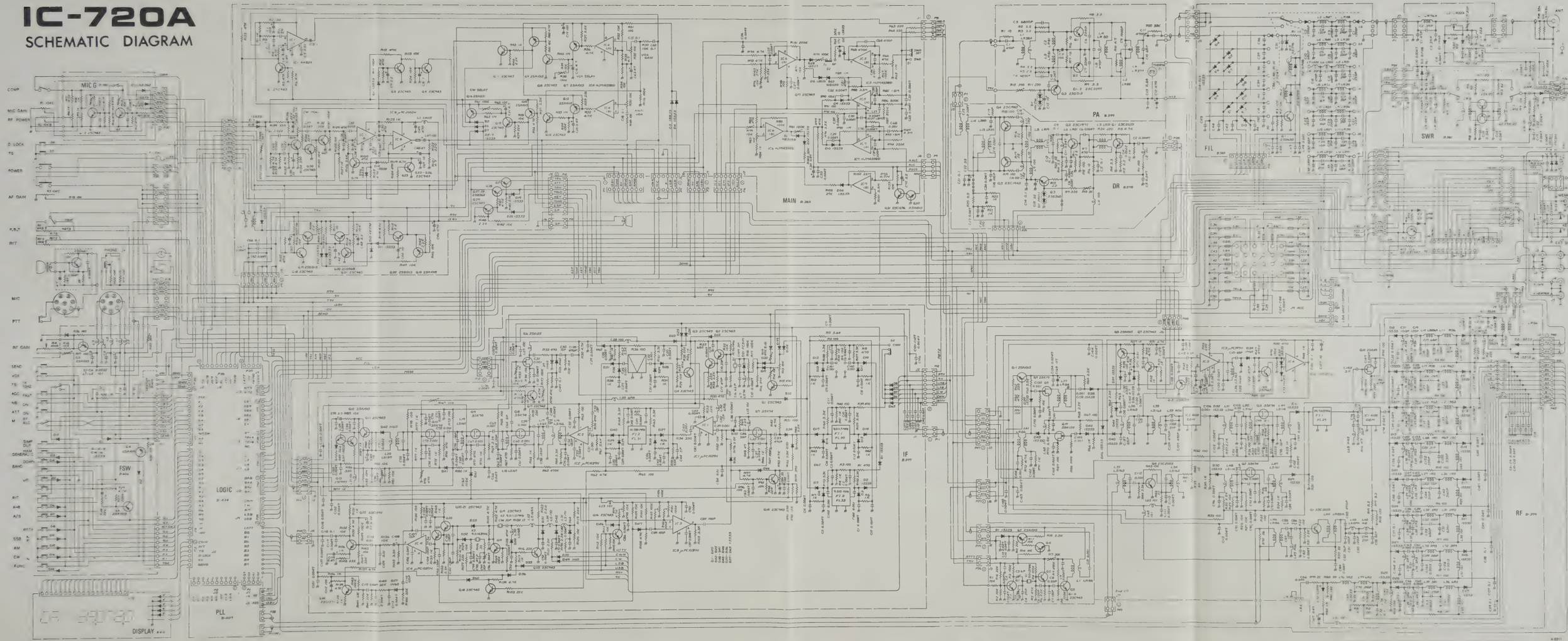
Any questions regarding service work performed or billing should be directed to the service center indicated above.

JAMES JOHNSON
6937 Rt. 65 E.S
NAPOLEON, OH 43545



IC-720A

SCHEMATIC DIAGRAM

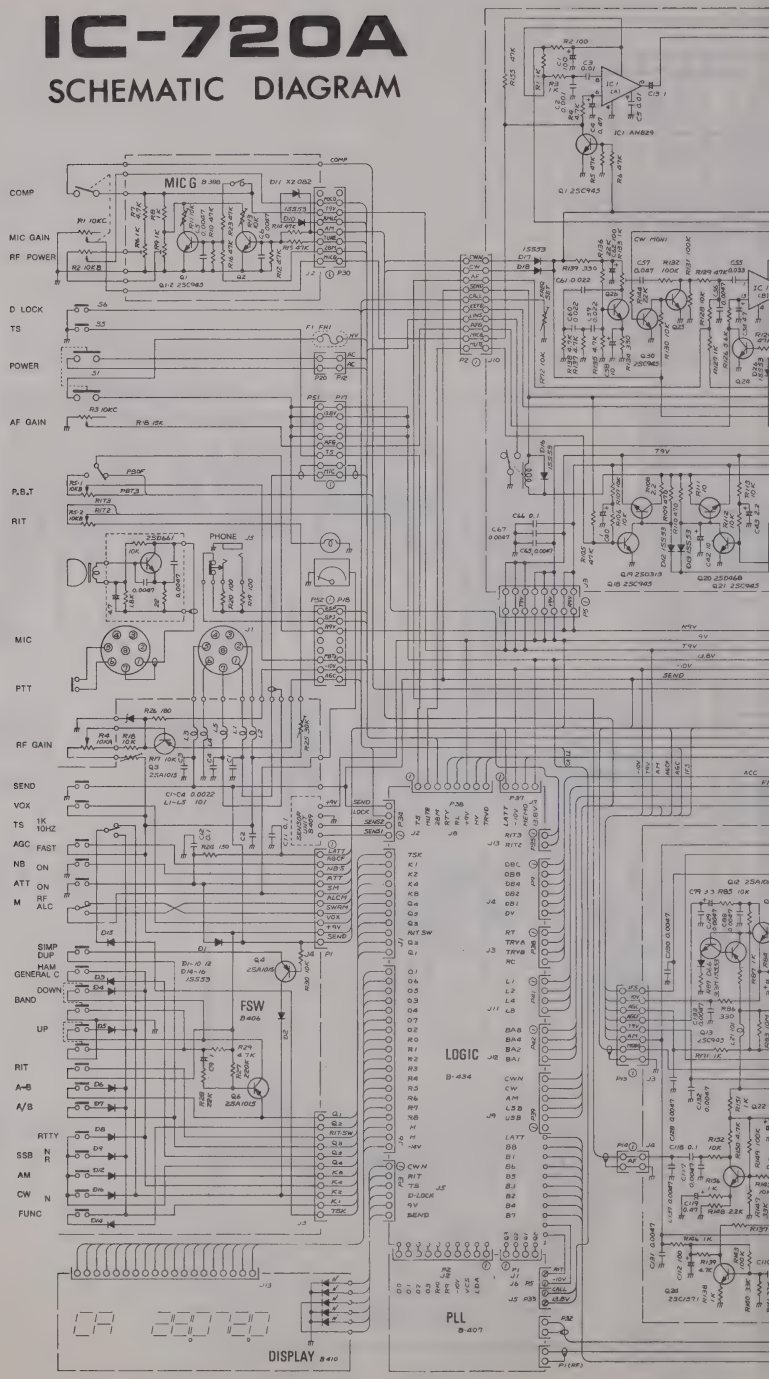


ICOM ICOM INCORPORATED

Some components subject to change for an improvement without notice.

IC-720A

SCHEMATIC DIAGRAM



9 - 4 PLL ADJUSTMENT

9 - 4 - 1 100Hz STEPS LOOP ADJUSTMENT

(a) Connect a syncroscope across Pin 12 of IC6 and ground. Adjust L20 and L21 so that the amplitude is maximum, and the waveform is rectangular.

(b) Ground Pin 15 of IC6 (or R41). Connect a frequency counter across R73 and ground. Adjust L2 for a frequency of 23.7MHz. (This is the free-run frequency.)

(c) Remove ground from Pin 15 of IC6, and the PLL should lock.
Tune to 7.101.4MHz and 7.101.5MHz alternately several times, and make sure the lock is steady. Tune 7.101.5MHz to 7.201.4MHz, and make sure the frequency changes from 13.15MHz to 23.14MHz with 10KHz steps.

(d) Tune to 7.101.4MHz, and adjust C90 for a frequency of 23.14000MHz.

9 - 4 - 2 TRACKING ADJUSTMENT

When performing this adjustment, attach the shieldng covers to the PLL unit.

(a) Set C7 and C63 at minimum capacitance.

(b) Connect a syncroscope or high impedance voltmeter such as a VTVM across Pin 1 of IC8 (or R53) and ground.

Tune to 10.960.0MHz, and adjust L13 for +2V on the syncroscope or voltmeter. Tune to 0.960.0MHz, and the voltage should be –4.5V, approximately.
Tune to 29.960.0MHz, and adjust L19 for +2V. Then tune to 10.960.0MHz, and the voltage should be –7V, approximately.

(c) Connect a syncroscope or voltmeter across R120 (or Pin 1 of IC3) and ground.

Tune to 0.960.0MHz, and adjust L4 for +2.5V, approximately.

Tune to 10.960.0MHz, and adjust L18 for +2.5V, approximately.

Tune to 10.960.0MHz, 20.960.0MHz and 29.960.0MHz, and make sure the voltage at each setting, is +2.5V, approximately.

If these voltages differ from +2.5V, adjust C7 when the voltage is higher than 2.5V at higher frequency. When the voltage is lower, adjust C63.

9 - 4 - 3 2nd L.O. ADJUSTMENT

(a) Connect an RF voltmeter and a frequency counter across Pin 2 of J4 and ground.

Adjust L14 and L15 so that the output voltage is the maximum.

(b) Place the set in LSB and 10Hz steps, and tune to 7.101.5MHz from a lower frequency.
At the moment the frequency display changes to 7.101.5, adjust R142 for a frequency of 30,720.000KHz.

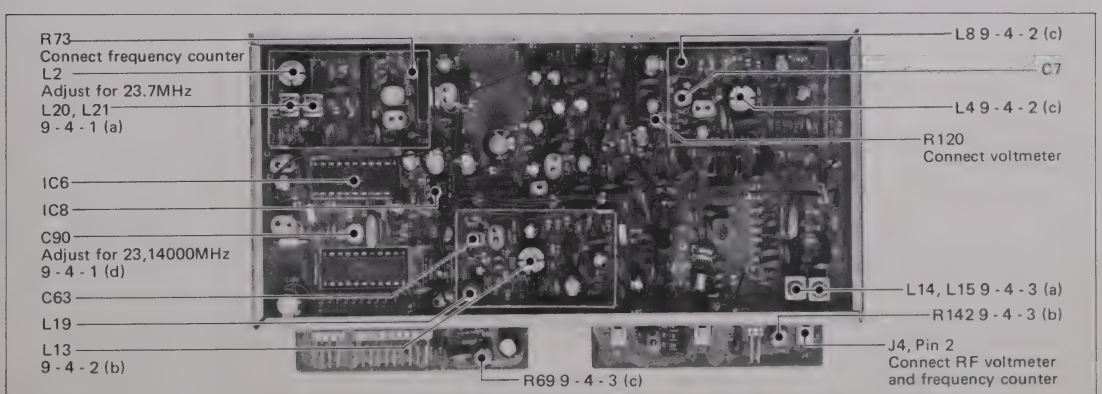
(c) Turn the tuning knob counterclockwise for 9 small vernier marks on the tuning scale (the display will show 7.101.4), and adjust R69 for a frequency of 30,719.910 KHz.

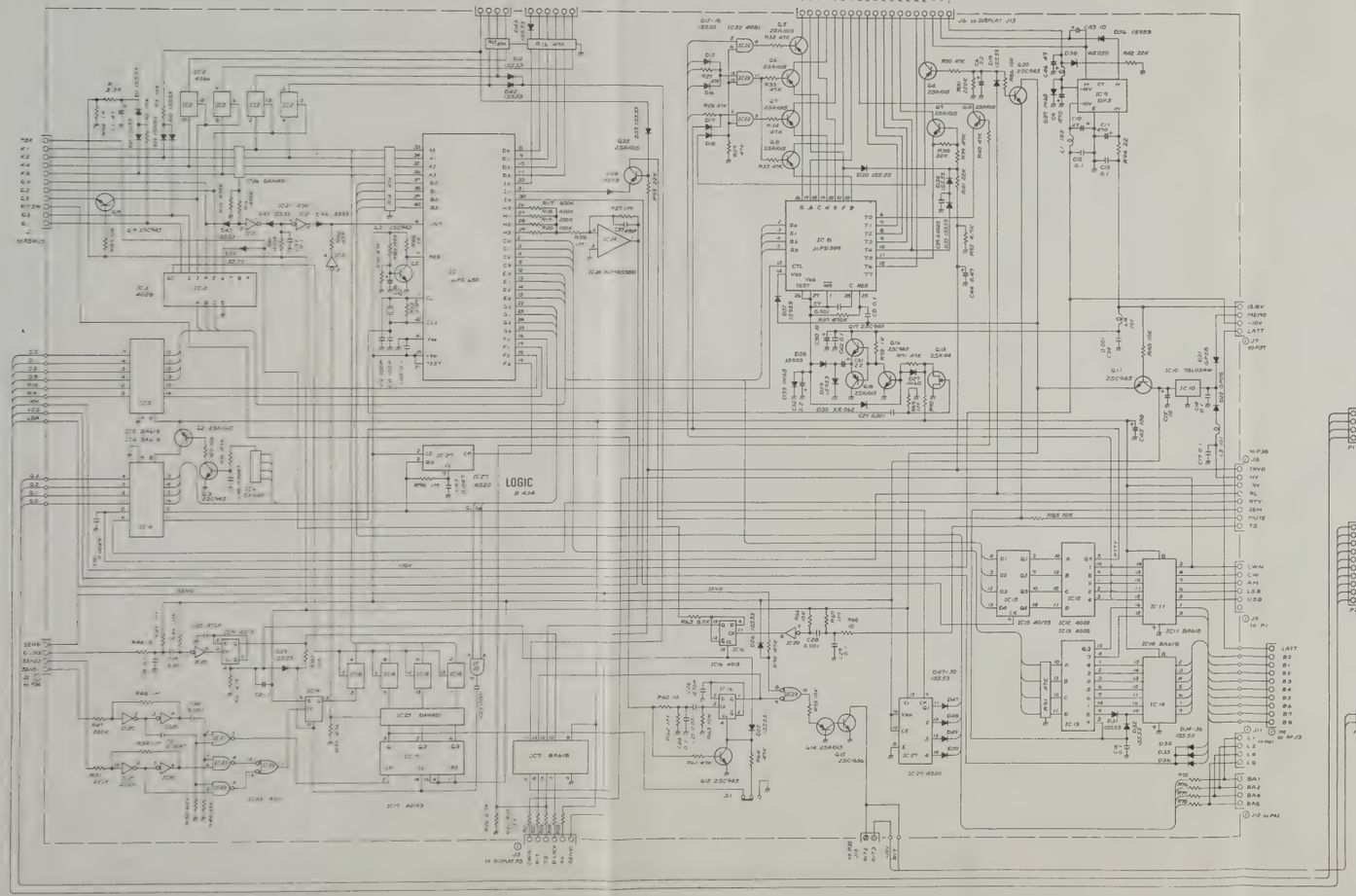
(d) Repeat (b) and (c), and make sure the frequency changes 10Hz on each small vernier mark.

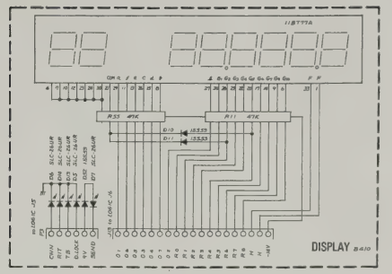
9 - 4 - 4 RIT FREQUENCY ADJUSTMENT

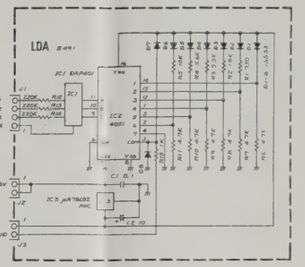
Connect a frequency counter across Pin 2 of J4 and ground.

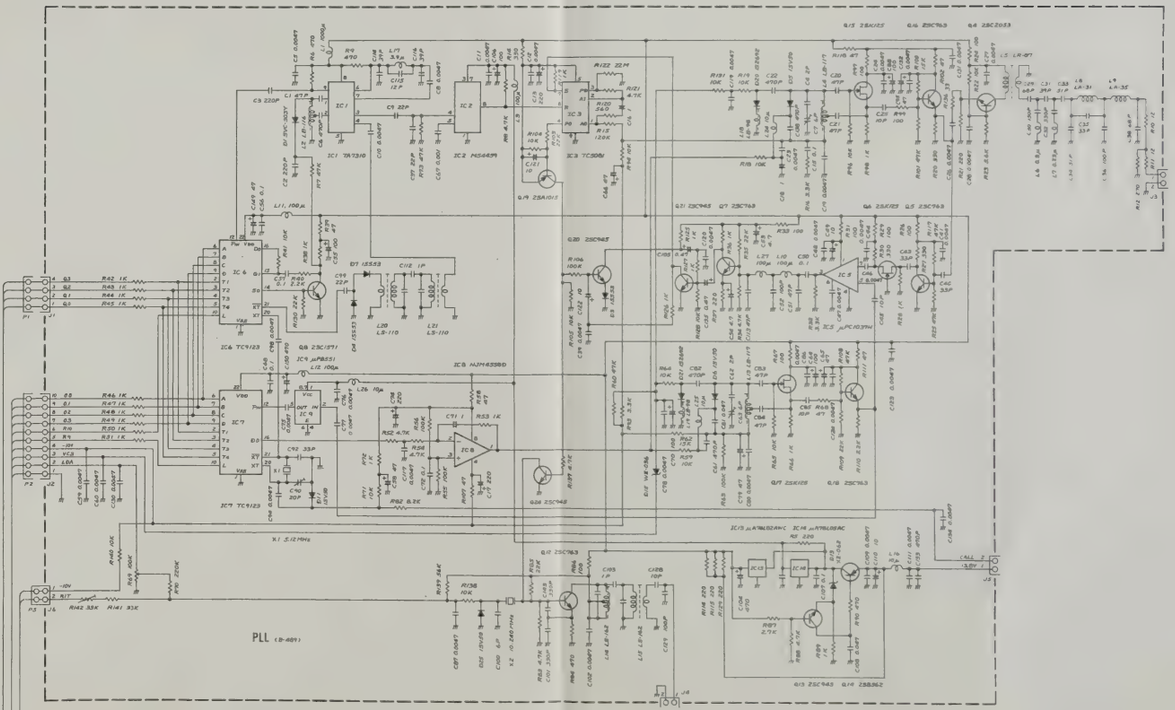
Set the RIT control knob in the center (• mark) position, and turn the RIT switch ON and OFF alternately.
Adjust R25 on the FRONT SWITCH board so that the frequency does not differ when the RIT switch is ON and OFF.



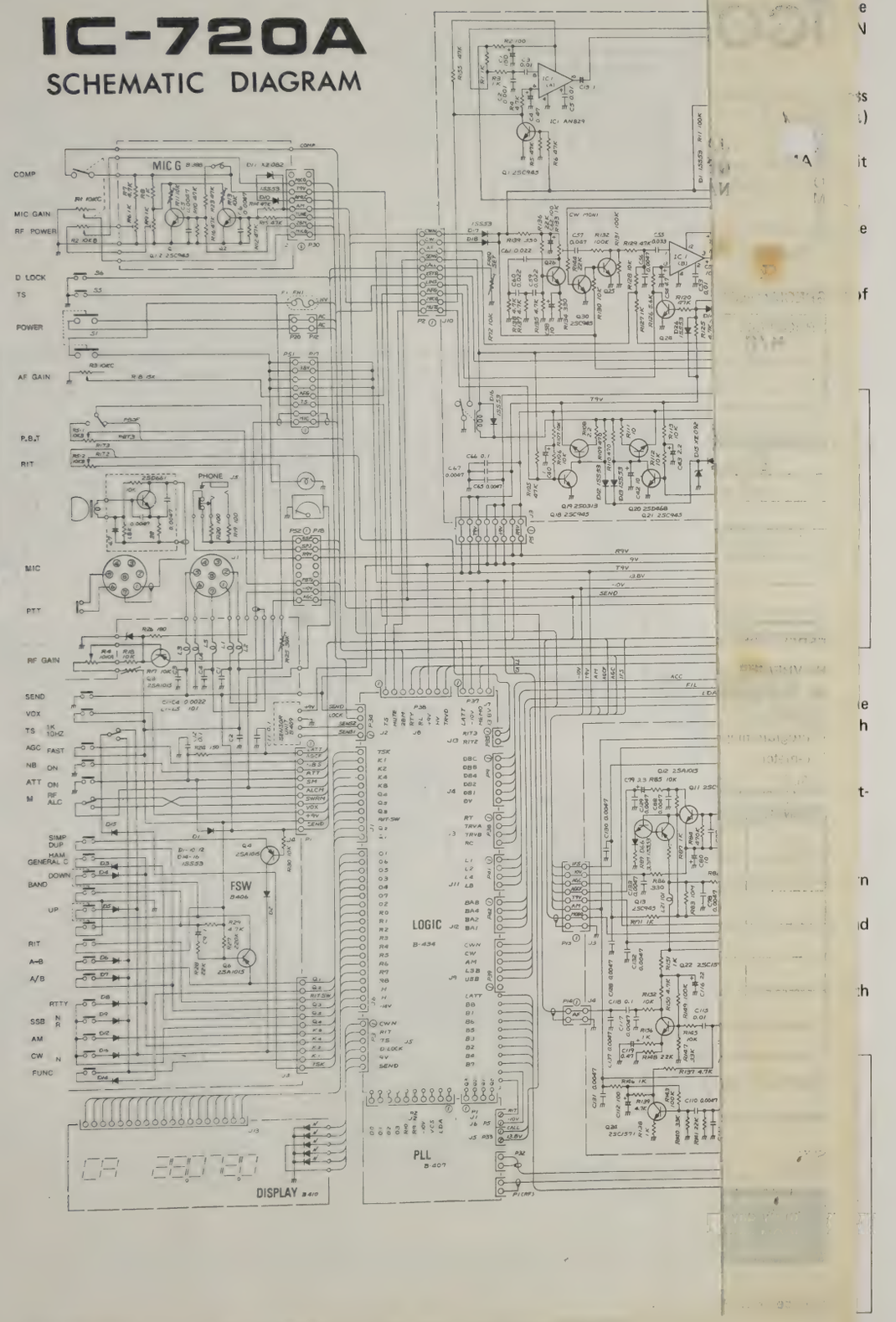

LOGIC
B-434


DISPLAY
B-410


LDA
B-491


PLL
(B-481)

IC-720A
SCHEMATIC DIAGRAM



9-4 PLL ADJUSTMENT

9-4-1 100Hz STEPS LOOP ADJUSTMENT

(a) Connect a syncroscope across Pin 12 of IC6 and ground. Adjust L20 and L21 so that the amplitude is maximum, and the waveform is rectangular.

(b) Ground Pin 15 of IC6 (or R41). Connect a frequency counter across R73 and ground. Adjust L2 for a frequency of 23.7MHz. (This is the free-run frequency.)

(c) Remove ground from Pin 15 of IC6, and the PLL should lock.
Tune to 7.101.4MHz and 7.101.5MHz alternately several times, and make sure the lock is steady. Tune 7.101.5MHz to 7.201.4MHz, and make sure the frequency changes from 13.15MHz to 23.14MHz with 10KHz steps.

(d) Tune to 7.101.4MHz, and adjust C90 for a frequency of 23.14000MHz.

9-4-2 TRACKING ADJUSTMENT

When performing this adjustment, attach the shieldng covers to the PLL unit.

(a) Set C7 and C63 at minimum capacitance.

(b) Connect a syncroscope or high impedance voltmeter such as a VTVM across Pin 1 of IC8 (or R53) and ground.

Tune to 10.960.0MHz, and adjust L13 for +2V on the syncroscope or voltmeter. Tune to 0.960.0MHz, and the voltage should be –4.5V, approximately.
Tune to 29.960.0MHz, and adjust L19 for +2V. Then tune to 10.960.0MHz, and the voltage should be –7V, approximately.

(c) Connect a syncroscope or voltmeter across R120 (or Pin 1 of IC3) and ground.

Tune to 0.960.0MHz, and adjust L4 for +2.5V, approximately.

Tune to 10.960.0MHz, and adjust L18 for +2.5V, approximately.

Tune to 10.960.0MHz, 20.960.0MHz and 29.960.0MHz, and make sure the voltage at each setting, is +2.5V, approximately.

If these voltages differ from +2.5V, adjust C7 when the voltage is higher than 2.5V at higher frequency. When the voltage is lower, adjust C63.

9-4-3 2nd L.O. ADJUSTMENT

(a) Connect an RF voltmeter and a frequency counter across Pin 2 of J4 and ground.

Adjust L14 and L15 so that the output voltage is the maximum.

(b) Place the set in LSB and 10Hz steps, and tune to 7.101.5MHz from a lower frequency.
At the moment the frequency display changes to 7.101.5, adjust R142 for a frequency of 30,720.000KHz.

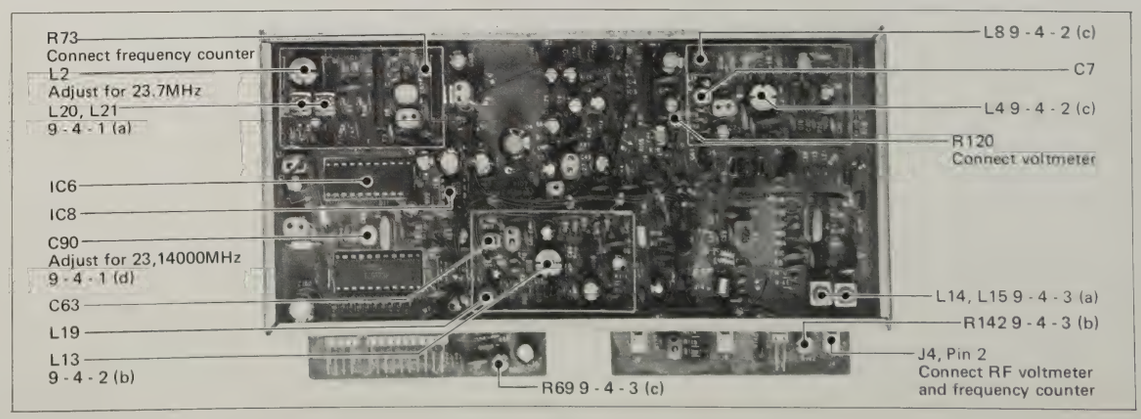
(c) Turn the tuning knob counterclockwise for 9 small vernier marks on the tuning scale (the display will show 7.101.4), and adjust R69 for a frequency of 30,719.910 KHz.

(d) Repeat (b) and (c), and make sure the frequency changes 10Hz on each small vernier mark.

9-4-4 RIT FREQUENCY ADJUSTMENT

Connect a frequency counter across Pin 2 of J4 and ground.

Set the RIT control knob in the center (• mark) position, and turn the RIT switch ON and OFF alternately.
Adjust R25 on the FRONT SWITCH board so that the frequency does not differ when the RIT switch is ON and OFF.



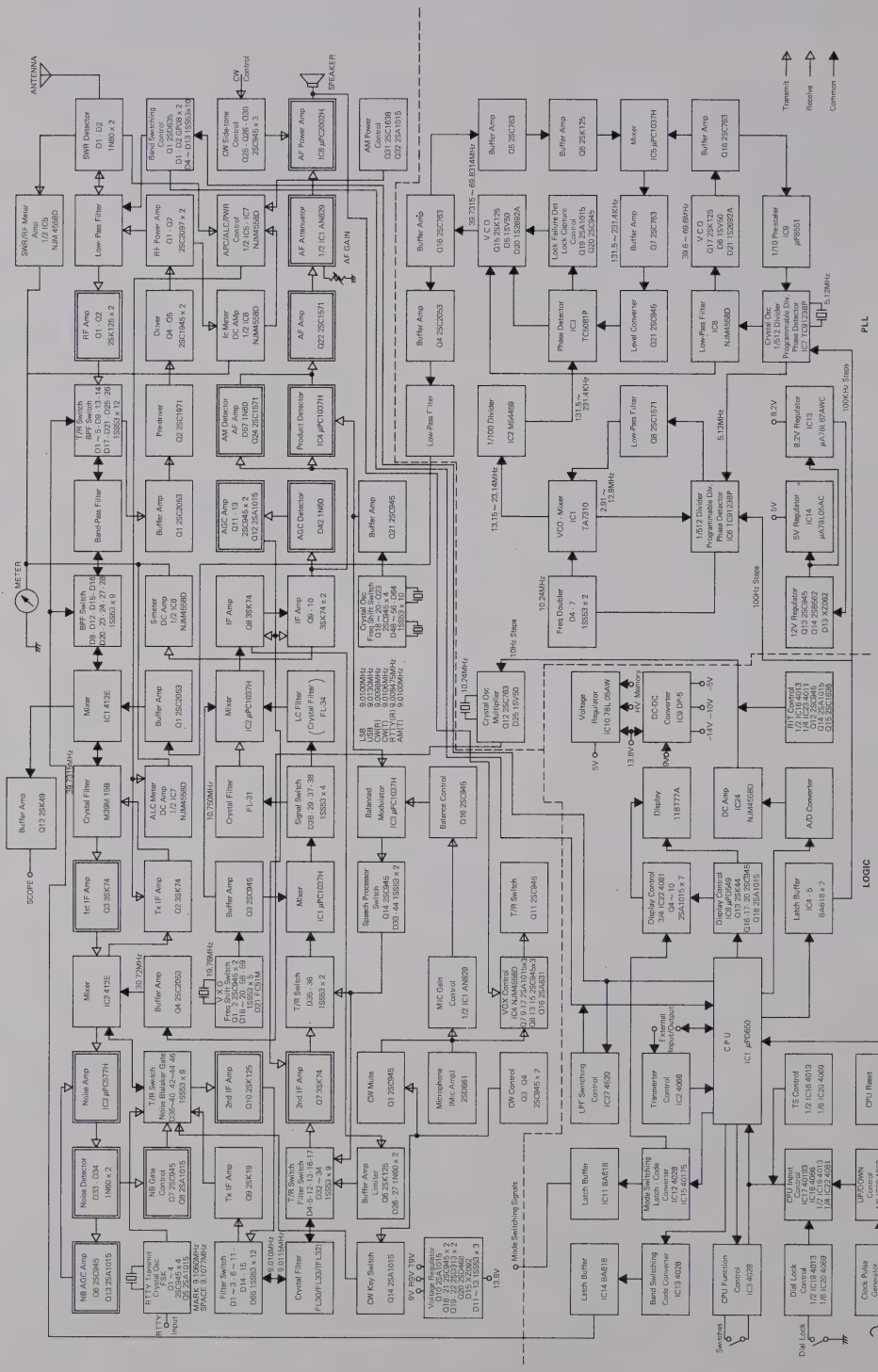
SECTION 10 TROUBLE SHOOTING

Your IC-720A has been carefully adjusted at the factory prior to shipping. The chart below has been provided to help you correct problems which are not equipment malfunctions. If you are unable to locate the trouble, or correct the fault, please contact your dealer or the nearest ICOM Service Center.

Problem	Possible Cause	Solution
1. Power does not come on when the switch is pushed.	Power cable is improperly connected.	Carefully reconnect power cable.
	Power cord is connected with the polarity reversed.	Disconnect the power cord, replace the blown fuse, then reconnect the power cord observing proper polarity.
	Blown fuse.	Check for the cause, then replace the fuse with a spare one.
		If using an IC-PS15, also check its fuse.
	IC-PS15 MAIN switch is in the OFF position.	Place MAIN switch in ON position.
2. No sound comes from the speaker.	AF GAIN control knob is completely counterclockwise.	Turn the knob clockwise to a suitable level.
	The unit is in the transmit mode, either by the T/R switch or the PTT switch on the microphone.	Put the unit in the receive mode.
	The external speaker cable is connected to the unit but not to the external speaker jack on the external speaker.	Connect the cable to the speaker jack on the external speaker.
	The internal speaker cable is not connected.	Connect the speaker connection.
	Headphones are connected to the PHONES jack.	Unplug the headphones.
3. Sensitivity is low and only strong signals are audible.	RF GAIN control knob is turned fully counterclockwise.	Turn the RF Gain control knob fully clockwise.
	The antenna feed line is cut or shorted.	Check the feed line and correct any improper condition.
	The Attenuator is ON.	Turn the Attenuator OFF.
4. During receive, the "S" meter is higher than the "0" position even when there is no signal.	RF GAIN control knob is turned fully counterclockwise.	Turn the knob fully clockwise.
5. Only incomprehensible voices are heard during SSB reception.	Receiving the wrong sideband.	Set the sideband opposite the one you are receiving, either USB or LSB.
6. The tone of the received signal is very high or low pitched.	Maladjustment of the P.B. Tune control.	Set the P.B. Tune control knob to the clear tone position, or P.B.T. OFF position.
7. No output power or low output power.	MIC GAIN setting is too low.	Turn the MIC GAIN control clockwise to the center (12 o'clock) position.
	When SSB is desired, but the MODE is in the CW or CW-N.	Set the MODE to the SSB (USB or LSB).
	PTT switch is not functioning due to improper connection of the mic connector.	Check the connection of the MIC connector and correct any problems.
	The antenna feed line is cut or shorted.	Check the antenna feed line and correct any improper connection.
8. The receive mode functions properly and your signals are transmitted, but you are unable to make contact with another station.	The SIMP/DUP switch is in the DUP position.	Set the SIMP/DUP switch to the SIMP position.
	The receive frequency is offset from the transmit frequency by the RIT control.	Turn OFF the RIT, or set the RIT control knob to the center (12 o'clock) position.
9. The right side of the unit case becomes a little hot.	As the right side of the case is used as a heat sink for the transmitter driver transistors, even during normal operation, it may get as hot as 35°C (95°F) above room temperature.	Make sure that the area around the unit has as much ventilation as possible.
10. The heat sink on the rear panel becomes hot.	The heat sink on the rear panel is for the final transistors and may become as hot as 40°C (104°F) above room temperature.	Make sure the area around the unit has as much ventilation as possible.

Problem	Possible Cause	Solution
11. The RIT LED goes out even though you did not depress the RIT ON/OFF switch to turn it OFF.	The RIT is automatically turned OFF when the Tuning Knob is rotated unless the interior RIT control switch is in the OFF position.	You may change the unit so that the automatic RIT OFF function does not operate when you rotate the Tuning knob. (See page 15.)
	The Power switch has been turned OFF.	Depress the RIT ON/OFF switch again to turn on the RIT.
12. The frequency does not change by rotating the Tuning knob.	DIAL LOCK is engaged.	Disengage the DIAL LOCK by pressing the DIAL LOCK button.
13. An abnormal figure is displayed on the frequency display or fails to illuminate.	The Power switch was turned OFF and ON too quickly.	Turn the Power switch OFF, wait 30 seconds, and then turn it ON again.
14. An unusual amount of distortion and/or noise in the transmit signal.	The MIC GAIN is too high when the RF Speech Processor is ON.	While watching the meter in the ALC mode, turn the MIC GAIN control counterclockwise so that the meter is within marked zone at the voice peak.
15. Unable to key when using an electronic keyer.	The Switching circuit of the electronic keyer does not close completely.	Replace the keyer with one having a voltage of less than 0.4V between the two keying lines at the key down position, or modify your keyer so that the voltage is less than 0.4 Volts.
	Polarity of the connection wires from the keyer is reversed.	Connect the keyer wires observing proper polarity.
	The MODE is not set to CW or CW-N.	Set the MODE to CW or CW-N.
16. In the AM mode there is no modulation.	Mic Gain is too low.	Adjust the Mic Gain clockwise.
	Mic connector loose, or microphone inoperable.	Check and tighten mic connections, replace mic if necessary.
17. When the set has been tuned to a frequency other than 7.100MHz Ham, or 15.0000 MHz General Coverage, and the set goes to one of those frequencies when turned ON.	Memory Backup is not connected to a power supply, or Memory Backup Power Supply has failed.	Check Memory Backup Power Supply for loose connections, or faults.

SECTION 11 BLOCK DIAGRAM

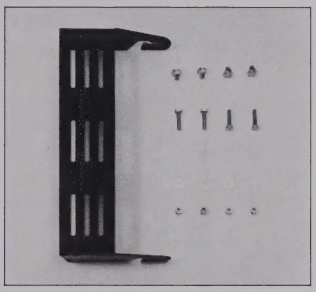

ANTENNA
SPEAKER
CW Control
SWR/PO Meter Amp 1/2 IC5 NJM 4558D
SWR Detector D1 · D2 1N60 x 2
Band Switching Control D1 · D2 GP08 x 2 D1 · D2 · D3 · D4 ~ D13 1SS53x10
CW Side-tone Oscillator Q25 · Q26 · Q30 2SC945 x 3
AF Power Amp IC9 μPC2002H
AM Power Control Q31 2SC1636 Q32 2SA1015
Transmit
Receive
Common
Low Pass Filter
H.F. Power Amp Q1 · Q2 · Q3 2SC2097 x 2
APC/ALC/PWR Det. 1/2 IC6 · IC7 NJM4558D
AF Attenuator 1/2 IC1 AN629
AF GAIN
Buffer Amp Q16 2SC763
Buffer Amp Q5 2SC763
Buffer Amp Q6 2SC763
Mixer IC5 μPC1037H
Buffer Amp Q18 2SC763
SWR/PO Meter Amp 1/2 IC5 NJM 4558D
RF Amp Q1 · Q2 2SK125 x 2
Driver Q4 · Q5 2SC1945 x 2
Ic Meter D1 ~ D4 1SS83 x 4 1/2 IC6 NJM4558D
AF Amp Q22 2SC1571
Buffer Amp Q4 2SC2053
V C O Q15 2SK125 D5 15V/50 D20 1S2692A
Lock Failure Det Lock Detection Control Q19 2SA1015 Q20 2SC945
Buffer Amp Q7 2SC763
V C O Q17 2SK125 D6 15V/50 D21 1S2692A
1/10 Pre-scaler IC9 μPB551
39.6 ~ 69.6MHz
131.5 ~ 231.4KHz
69.7315 ~ 69.8314MHz
5.12MHz
T/R Switch BPF Switch D1 ~ D5 · D9 · 13 · 14 D17 · D21 · D25 · 26 1SS83 x 12
Pre-driver Q2 2SC1671
AM Detector D57 1N60 Q24 2SC1571
Product Detector IC4 μPC1037H
Low-Pass Filter
1/100 Divider IC2 MB4469
Phase Detector IC3 TC9081P
Low-Pass Filter Q8 2SC1571
Level Converter Q21 2SC945
Low-Pass Filter IC8 NJM4558D
Crystal Osc. 1/8 1/2 Divider Programmable Div. Phase Detector Q71 1G913B
5.12MHz
PLL
Band-Pass Filter
Buffer Amp Q1 2SC2053
AGC Amp D31 · 33 2SC945 x 2 Q12 2SA1015
AGC Detector D42 1N60
Buffer Amp Q21 2SC945
VCO · Mixer IC1 TA7310
2.91 ~ 12.9MHz
1/512 Divider Programmable Div. Phase Detector IC61 TC9132BP
5V
8.2V
8.2V Regulator IC13 μA78L82AWC
100KHz Steps
BPF Switch D8 · D12 · D16 · D18 D20 · 24 · 28 · 29 1SS83 x 9
Smeter DC Amp 1/2 IC8 NJM4558D
IF Amp Q8 3SK74
IF Amp D9 · 10 3SK74 x 2
Crystal Osc. Freq Shift Switch Q27 · 28 2SC945 x 4 D44 · 45 · 52 · 54 1SS83 x 10
Freq Doubler D4 · 7 1SS83 x 2
10.24MHz
1/512 Divider Programmable Div. Phase Detector IC61 TC9132BP
5V
5V Regulator IC14 μA78L05AC
10Hz Steps
100Hz Steps
Mixer IC1 412E
Buffer Amp Q1 2SC2053
Mixer IC2 μPC1037H
LC Filter (Crystal Filter) FL-34
9.0100MHz USB 9.0138MHz CW(T) 9.0106MHz CW(R) 9.0084MHz AM(T) 9.0100MHz
Crystal Osc Multiplier Q12 2SC763 D25 15V/50
10.24MHz
Voltage Regulator IC10 78L05AW
H/V Memory
DC-DC Converter IC9 DP-5
-10V ~ -50V -5V
12V Regulator Q13 2SC945 Q14 2SA1015 D13 XZ062
Crystal Filter M39W 15B
ALC Meter DC Amp 1/2 IC7 NJM4558D
Crystal Filter FL-31
Signal Switch D28 · 29 · 37 · 38 1SS83 x 4
Balanced Modulator IC3 μPC1037H
Balance Control D19 2SC945
13.8V
Display 118T77A
DC Amp IC24 NJM4558D
A/D Converter
RIT Control 1/2 IC10 4013 1/4 IC23 4011 D13 · 14 1SS83 x 2 Q14 2SA1015 Q12 2SC1588
30.72MHz
10.750MHz
30.731MHz
SCOPE
1st IF Amp Q23 3SK74
Tx IF Amp Q2 3SK74
Buffer Amp Q3 2SC945
Mixer IC1 μPC1037H
Speech Processor Switch Q14 2SC945 D33 · 44 1SS83 x 2
T/R Switch Q11 2SC945
Display Control 3/4 IC22 4081 Q4 · 5 · 15 2SA1015 x 7
Display Control IC8 μPD546 IC22 4081 Q16 · 17 2SC945 Q18 2SA1015
Latch Buffer IC4 · 5 BA618 x 7
Mixer IC1 412E
Buffer Amp Q4 2SC2053
V.X.O Freq Shift Switch D13 · 14 2SC945 x 2 D18 ~ 20 · 58 · 59 1SS83 x 4 D27 FC51M
T/R Switch D26 · 36 1SS83 x 2
Mic Gain Control 1/2 IC1 AN629
VOX Control Q6 NJM4558D Q7 · 8 2SA1015 D8 13 15 2SD34x3 Q18 2SA931
Microphone (Mic Amp) 2SD681
LPF Switching Control IC27 4520
Transverter Control IC2 4066
C P U IC1 μPD650
External Input/Output
Noise Amp IC3 μPC577H
T/R Switch Noise Bialaker Gate D38 ~ 40 · 42 ~ 44 46 1SS83 x 8
2nd IF Amp Q10 2SK125
2nd IF Amp Q7 3SK74
CW Mute Q1 2SC945
CW Control Q3 · Q4 2SC945 x 2
Noise Detector D33 · D34 1N60 x 2
NB Gate Control Q17 2SC945 Q18 2SA1015
Tx IF Amp Q9 2SK19
T/R Switch Filter Switch D4 ~ 5 · 12 · 13 · 16 · 17 D32 ~ 34 1SS83 x 9
Buffer Amp Q6 2SK125 D26 · 27 1N60 x 2
Mode Switching Signals
Latch Buffer IC11 BA618
Mode Switching Logic Code Converter IC12 4028 IC15 4075
TS Control 1/2 IC16 4013 1/6 IC20 4069
CPU Reset Q21 2SC945
NB AGC Amp Q6 2SC945 D13 2SA1015
R.I.T/V.Transmit Osc. Switch FS1 Q5 2SC945 x 4 Q9 2SA1015 D14 · 15 1SS83 x 2
MARK 9.1067MHz SPACE 9.1077MHz
Filter Switch D1 ~ 3 · 6 ~ 11 D14 · 16 1SS83 x 12 D65 1SS83 x 2
9.0100MHz 9.0113MHz
Crystal Filter FL30(FL32)/(FL32)
CW Key Switch Q14 2SA1015
9V REV 15V 12.5V
Voltage Regulator Q10 2SA1015 Q12 2SC1588 D18 · 22 2SD313 x 2 D15 · 16 1SS83 x 2 D11 ~ 13 1SS83 x 3
Latch Buffer IC14 BA618
Band Switching Logic Code Converter IC13 4028
CPU Function Control IC3 4028
Dial Lock Control 1/2 IC19 4013 1/6 IC20 4069
UP/DOWN Control 4/6 IC20 4069 3/4 IC22 4011 1/4 IC21 4001
Clock Pulse Generator IC1 · 2 CN1130 x 2
Switches
Dial Lock
TUNE
LOGIC
PLL

IC-PS15
AC POWER SUPPLY

IC-SP3
EXTERNAL SPEAKER

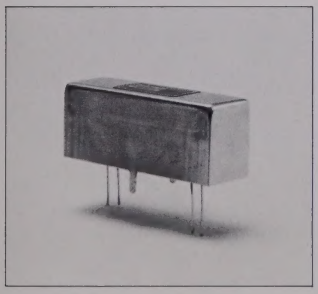
IC-SM5
DESK MICROPHONE
ELECTRET CONDENSER
TYPE

IC-HP1
HEADPHONES



IC-MB5
MOBILE MOUNTING
BRACKET

BC-10A
MEMORY BACKUP
AC POWER SUPPLY



FL-32
CW NARROW
CRYSTAL FILTER

FL-34
AM PASS BAND TUNE
CRYSTAL FILTER

IC-2KL
500W SOLID-STATE LINEAR AMPLIFIER
IC-2KLPS
ATTENDANT POWER SUPPLY
FOR IC-2KL

MEMO

CAUTION

This set employs a microcomputer to control frequencies, operating mode and display.

The microcomputer has a program to initialize the operating condition of the set. However, sometimes an abnormal figure may be displayed on the display, or the display fails to illuminate.

This may be caused by an intermittent connection of the power plug or the power switch being turned OFF and ON to quickly.

This is not an equipment malfunction. When this occurs, it may be solved with the following simple procedure:

1. Turn OFF the set's power switch.
2. If the set has a memory switch, turn OFF this switch also.
3. If you use a memory backup power supply, unplug its power connector.
4. Unplug the power plug of the set.
5. Wait at least 45 seconds and reconnect the power plug to the set.
6. Turn ON the power switch.
7. Make sure the set has the correct startup readout.
   (If not, repeat the above procedure.)
8. Turn ON the memory switch (when the set has one), connect the memory backup power connector (when used).

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